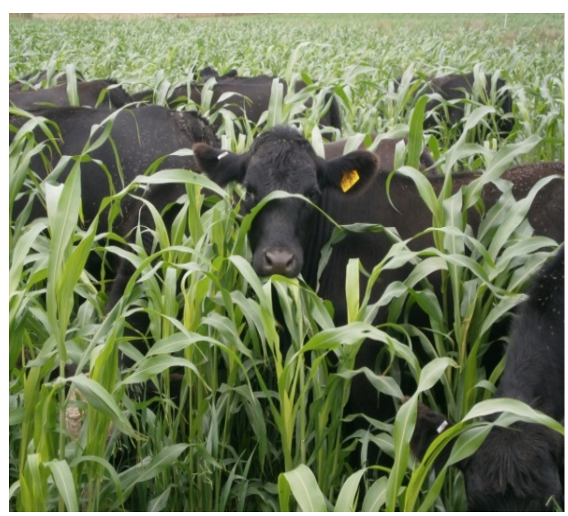
ANNUAL PROGRESS

REPORT 2016

SOUTHEAST SOUTH DAKOTA EXPERIMENT FARM

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

SOUTH DAKOTA STATE UNIVERSITY



This is an annual report of the research program at the Southeast South Dakota Research Farm in cooperation with South Dakota Agricultural Experiment Station, SDSU Plant Science, and SDSU Animal Science and has special significance for those engaged in agriculture and the agriculturally related businesses in the ten county area of Southeast South Dakota. The results shown are not necessarily complete or conclusive. Interpretations given are tentative because additional data resulting from continuation of these experiments may result in conclusions different from those based on any one year.

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The Southeast Farm is located at 29974 University Road, Beresford, SD 57004. Telephone 605-563-2989; Fax 605-563-2941; Farm Supervisor, Peter Sexton email (peter.sexton@sdstate.edu).

Internet web page: http://www.sdstate.edu/ps/research/farms/southeast/index.cfm

RESEARCH FARM EMPLOYEES

Peter Sexton, Farm Supervisor
Sheila Price, Research Assistant
Doug Johnson, Senior Ag Technician
Sara Berg, Research Assistant (part-time)
Kevin Henseler, Ag Technician (Summer)
Brad Rops, Operations Manager
Ruth Stevens, Senior Secretary
Garold Williamson, Ag Foreman
Duane Auch, Research Assistant (part-time)

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South Dakota State University, South Dakota Counties and U.S. Department of Agriculture Cooperating.

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ACKNOWLEDGEMENTS

This year we say good-bye to a couple of Southeast Farm employees who have done a lot to keep the farm operating. Miss Sheila Price, research assistant - livestock, has taken a job in private industry closer to family. Sheila has worked at Southeast Farm for almost two years and has been a dependable person managing livestock operations. Mr. Doug Johnson, Senior Ag Technician, who has worked at Southeast Farm for almost eight years, has decided to retire. Doug has routinely performed many operations on the farm, including planting small grains, cover crops and row crops; equipment maintenance, and collecting data for research trials. We will miss both of them and wish them well in the future.

The remaining staff at the farm - Garold Williamson, Ruth Stevens, Brad Rops, and myself – should be here (I hope) to work through the coming season, and we may bring some new faces on board. The farm would not get very far in terms of research work done without the good work and dedication of the permanent staff. Kevin Henseler, Ben Brockmueller, and Duane Auch worked at the farm on part-time basis this past year and did great work. Many researchers on SDSU campus in Brookings and in SDSU Extension contribute toward the work done at the Southeast Farm and should also be acknowledged and thanked for all the effort they put forth in promoting agricultural research in South Dakota. The Soybean Council and the Corn Council support the farm through research grants and need to be acknowledged for their help. Our friends at the NRCS also support research at the farm and work with us on outreach activities – so I want to acknowledge them as well. The Southeast Farm Board needs to be acknowledged for their critical contribution to the research farm and its continued success.

Support of the Ag Experiment Station at SDSU led by Dr. Daniel Scholl, Director, and Dr. Bill Gibbons Interim Associate Director, Dr. David Wright, Dept. Head Plant Science, and Dr. Joe Cassidy, Dept. Head Animal Science, have also been important for the farm's operation. We look forward to continuing and expanding our interaction with SDSU faculty and college administrators in the coming year.

As always, we are thankful to God for yet another year that we can move forward with work, and we look forward with a good hope and a good will that this coming season will be a productive one.

This publication was edited and compiled by Ruth Stevens and Peter Sexton. The 2016 Annual Report, as well as Annual Reports from other years, is available on SDSU website: http://www.sdstate.edu/south-dakota-agricultural-experiment-station/annual-reports

OUTREACH ACTIVITIES

Summer Research Day; July

Fall Field Day - Cover Crops & Livestock; September

Sponsor for Managing Soil Conference; November

Sponsor Seminars at Dakota Farm Show; January

INTRODUCTION ……………………………..…………………….……..Peter Sexton
Farm Supervisor

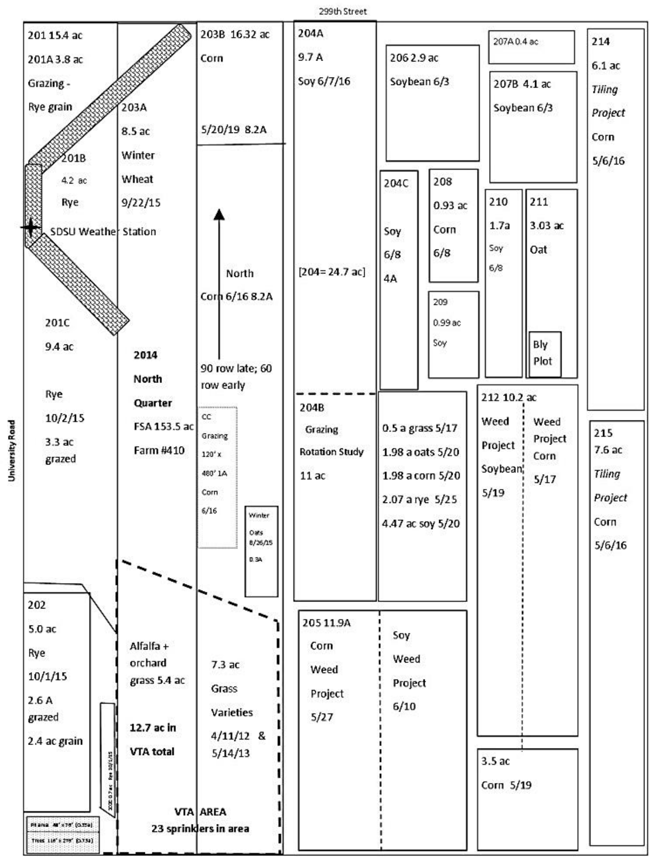
To me, the salient feature of the 2016 season was the wet spring. We didn't finish planting corn and beans until well into June. This brought into sharp relief some of the drainage problems we have at the farm. Some of these problem areas we just tried to work around in previous years, but this season we had large blocks that we couldn't get into until mid-June. We even had some oats drown out that had been seeded earlier in the spring. Partly as a result of all this, the Board of Directors of the research farm is looking at a major investment in drainage at the farm. The intention is to put in several new tile lines over the next few years and also put in a "bio-filter" (either a wood-chip bed the discharge water flows through, or a drainage field/managed wetland, or both) to improve quality of the discharge water before it leaves the farm.

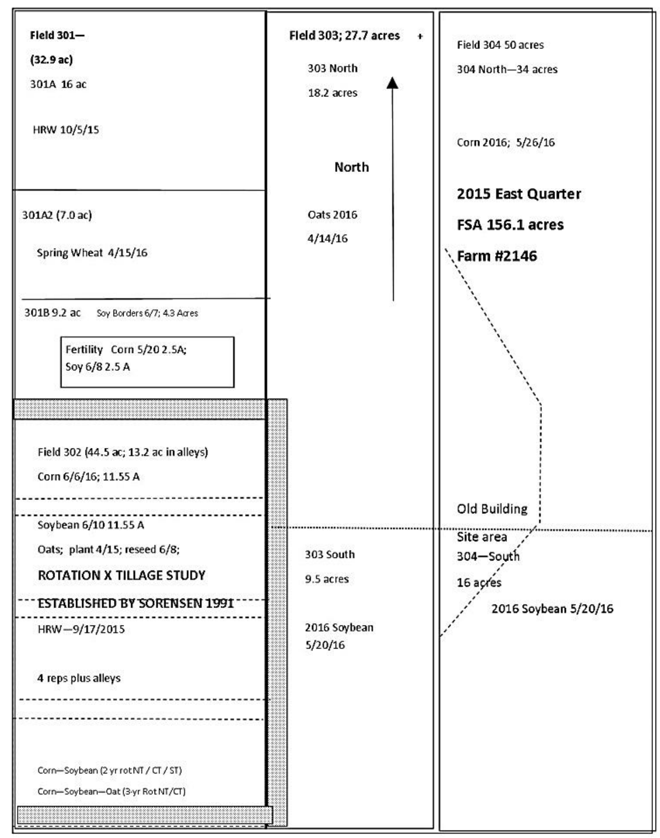
Using annual forages and cover crops for grazing, we hope will continue to be one of our research areas in the coming year. Improvements to the feedlot are practically done so we should be able to start feeding trials with finishing beef cattle in the near future. We are testing out two new crops for our area: winter canola and soft white winter wheat. God willing, they will survive the winter well and we'll have some new crops to market in the coming year. If circumstances allow, we will try some double cropping with winter triticale raised for silage followed by soybeans. We hope to continue the high-tunnel work with fruit trees. Of course, we plan to carry on with our collaborators at SDSU to facilitate their work with crop performance testing of corn and soybean lines, herbicide and fungicide evaluations, tile drainage, fertilizer and seed treatments, swine nutrition and feedlot rations. These things may not seem glamorous, but they represent the management details that often make the difference between profit and loss, or success and failure, in crop and livestock production.

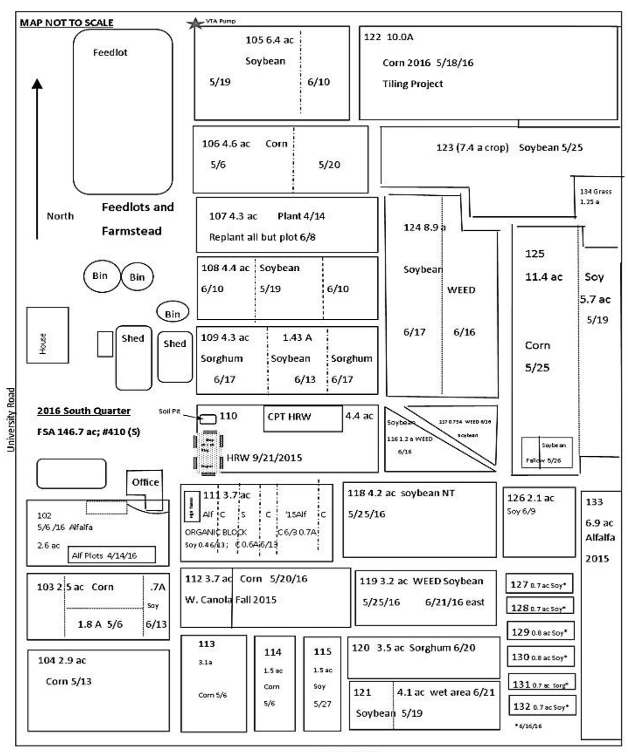
The farm's strategic goals continue to be: 1) Improve character of the soil (soil quality); 2) Achieve grain yield goals and optimize cost of production and profitability; 3) Optimize livestock production including use of novel approaches in integrating livestock and crop production; 4) Increase association membership and improve public relations and outreach; 5) Broaden scope of research to include small-scale and beginning farmers and horticulture work as opportunity permits. Our overall objective is to contribute to the public welfare for folks in southeast South Dakota by conducting unbiased agricultural research. This annual report is part of our effort to deliver on this objective. I hope this report is of value for your operation. It represents the work of many faculty and staff from SDSU as well as the crew at the research farm. We are always looking to improve on our efforts and like to listen to new ideas - please feel free to stop in and visit or call to share suggestions and comments about our research. We plan to have our summer field day on July 11, and a fall one on September 7, God willing. We hope that you can make it to Beresford for both events. We hope you have a good year ahead.

2016 Southeast Farm Land Use Map

(maps not drawn scale)







SOUTHEAST RESEARCH FARM ANNUAL REPORT
South Dakota State University
2015 Progress Report
Agricultural Experiment Station
Plant Science Department
South Dakota State University, Brookings, SD 57007
Southeast Research Farm, Beresford SD 57004

WEATHER AND CLIMATE SUMMARY

Ruth Stevens*, Peter Sexton, Brad Rops, Doug Johnson, Garold Williamson, and Sheila Price

2016 brought above average moisture during spring planting and again in late summer at the Southeast Research Farm. Spring moisture caused planting delays as many fields were saturated and could not be planted until June; however, that moisture also helped to carry the crops through a dry period in mid-summer with minimal stress. The moisture received in late August and in September allowed crops to complete growth cycle without stress. October had below normal precipitation allowing row crops to mature and fields to dry permitting harvest to be completed before above average November and December precipitation occurred.

The 2016 weather and climate information is highlighted in tables and graphs on pages 2-6.

In 2016, the months of February, March, June, September, October, and November had above average maximum temperatures. (Table 1) The months of July and December had below normal minimum temperatures; the balance of the year had above normal minimum temperatures. The 2016 growing season had four months (April, May, July, August) with below average maximum temperatures; while July was the only month with below normal minimum temperatures.

The coldest and hottest temperatures of the year were recorded on December 18 (-29°F) and June 12 (98°F) respectively, a 127-degree temperature range. Frost-free season at the Southeast Farm in 2016 was 168 days on a 32°F basis and 174 days on a 28°F-basis. Both the last spring frost and last freeze was on April 12 (22˚ F). The first fall frost was on October 7 (31˚F) and a freeze occurred on October 13 (28˚F). The average annual high temperature was 60°F and average annual low temperature was 38°F; which were both above average (+1.4 and +2.5 degrees, respectively).

Annual precipitation and growing season precipitation were both above average in 2016. Southeast Farm received 32.04 inches of annual precipitation, which is 126% of normal (Table 2 and 3). Growing season precipitation measured from April through September was 23.69 inches (124% of the normal). Southeast Farm had seven months in 2016 that received above average precipitation (+0.16” to +4.49”), and five months with below normal precipitation (-0.08” to -3.07”). In 2016 Southeast Farm received 29.1 inches of snowfall; 24 inches fell during the first half of the year and 6 inches fell in November and December.

The 2016 growing season (April – October) accumulation of growing degree units (GDU’s) was 3211 units (108% of average), with all months except August having above normal GDU’s. Evaporation recorded from the evaporation pan located at the Southeast Research Farm during May through September 2016 was 33.2 inches. Southeast Research Farm received 19.5 inches of rainfall during the same period of time.

* *Corresponding author: Ruth.Stevens@sdstate.edu*

Table 1. Temperatures[a] at the Southeast Research Farm - 2016

	2016 Average Air Temps. (°F)		64-year Average Air Temps. (˚F)		Departure from 64-year Average (˚F)	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
January	25.3	7.4	26.6	5.7	-1.3	+1.7
February	35.5	19.4	32.1	11.1	+3.4	+8.3
March	52.1	27.8	44.2	22.9	+7.9	+4.9
April	58.9	36.9	60.2	35.2	-1.3	+1.7
May	70.6	47.7	72.0	47.3	-1.4	+0.4
June	85.5	60.9	81.4	57.7	+4.1	+3.2
July	85.8	61.5	86.0	62.0	-0.2	-0.5
August	83.3	60.0	84.0	59.4	-0.7	+0.6
September	76.2	52.7	75.6	49.2	+0.6	+3.5
October	62.8	39.5	63.5	37.6	+0.7	+1.9
November	53.9	30.1	45.4	23.8	+8.5	+6.3
December	29.6	9.8	30.7	11.5	-1.1	-1.7

[a] Computed from daily observations

Table 2. Precipitation at the Southeast Research Farm – 2016

Month	Precipitation 2016 (inches)	64-year Average (inches)	Departure from Avg. (inches)
January	0.38	0.46	-0.08
February	0.97	0.81	+0.16
March	1.59	1.42	+0.17
April	4.16	2.55	+1.61
May	6.49	3.49	+3.00
June	1.12	4.19	-3.07
July	1.84	3.10	-1.26
August	2.82	2.98	-0.16
September	7.26	2.77	+4.49
October	2.49	1.86	-0.82
November	1.82	1.16	+1.05
December	1.10	0.66	+0.63
Totals	32.04	25.35	+6.59

ACKNOWLEDGEMENTS

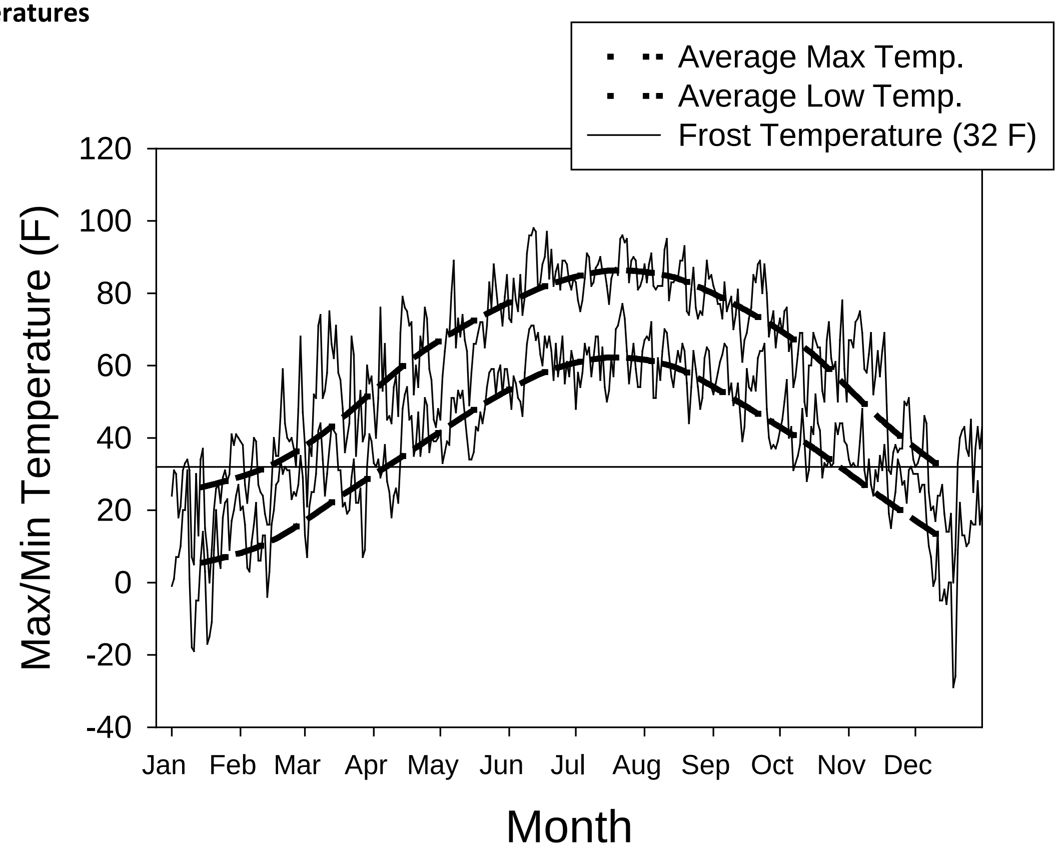
Weather data is compiled from daily observations collected by Southeast Farm Personnel in cooperation with South Dakota State Climatologist, South Dakota Office of Climatology and SDSU Extension, and the National Weather Service, Sioux Falls, SD. More climate information available at South Dakota State University – South Dakota Climate and Weather site: http://climate.sdstate.edu/

Table 3. 2016 Climate Summary for Southeast Research Farm, Beresford, SD

Annual Precipitation (inch)	32.04	126%*
Growing Season Precip (Apr-Sep, inch)	23.71	124%
Jan-Mar	2.94	110%
Apr-Jun	11.77	115%
Jul-Sep	11.92	135%
Oct-Dec	5.41	147%
Annual Snow (inch); (Jan-Jun/Jul-Dec)	23.5/5.6	29.1 total
Growing Degree Units (GDU); Apr – Oct	3211	108%
Minimum / Maximum Air Temp, ºF	-29° F Dec 18	98° F Jun 12
Last Spring Frost; 32º / 28º basis	Apr 12 - 22°F	Apr 12 - 22°F
First Fall Frost; 32º / 28º basis	Oct 7 - 31°F	Oct 13 - 28°F
Frost Free Period (days); 32º / 28º basis	168	174
Average Annual High / Low	60 / 38	+1.4 / +2.5

% of Normal

Figure 1. 2016 Average Temperatures and Observed Daily Maximum and Minimum Temperatures



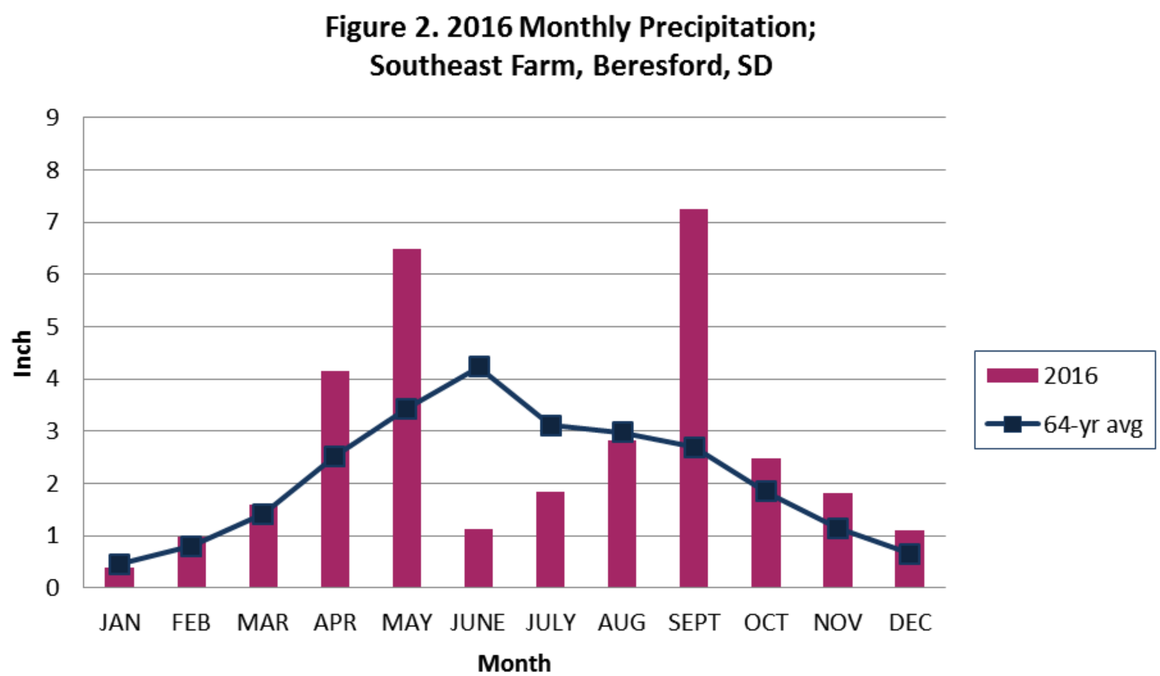


Figure 2. 2016 Monthly Precipitation;
Southeast Farm, Beresford, SD
9
8
7
6
5
4
3
2
1
0
Inch
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC
Month
2016
64-yr avg

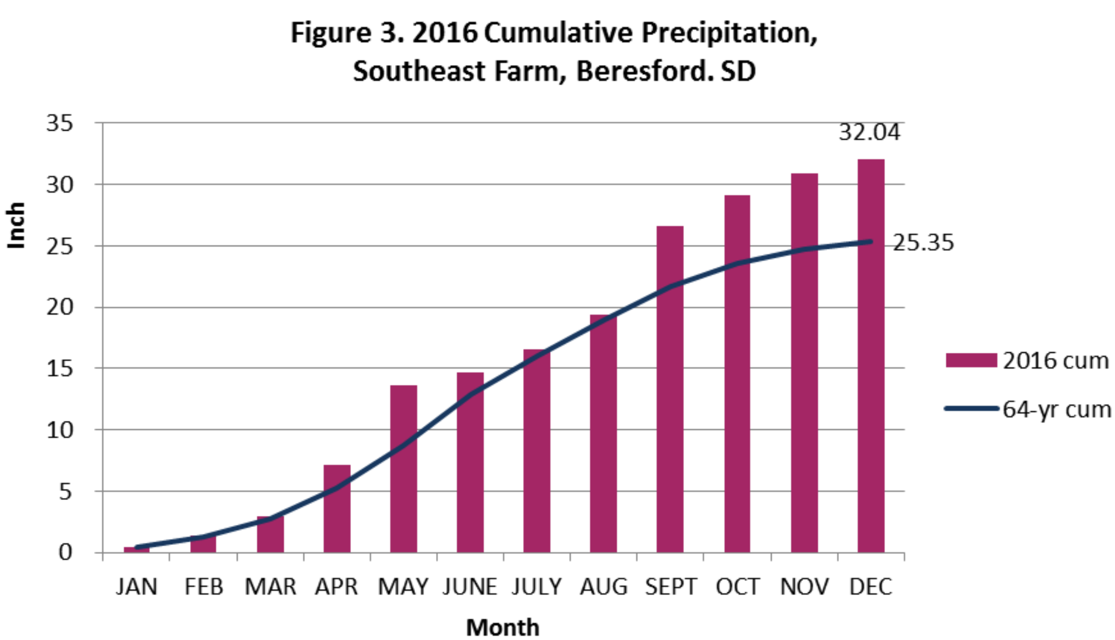


Figure 3. 2016 Cumulative Precipitation,
Southeast Farm, Beresford. SD
35
30
25
20
15
10
5
0
Inch
32.04
25.35
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC
Month
2016 cum
64-yr cum

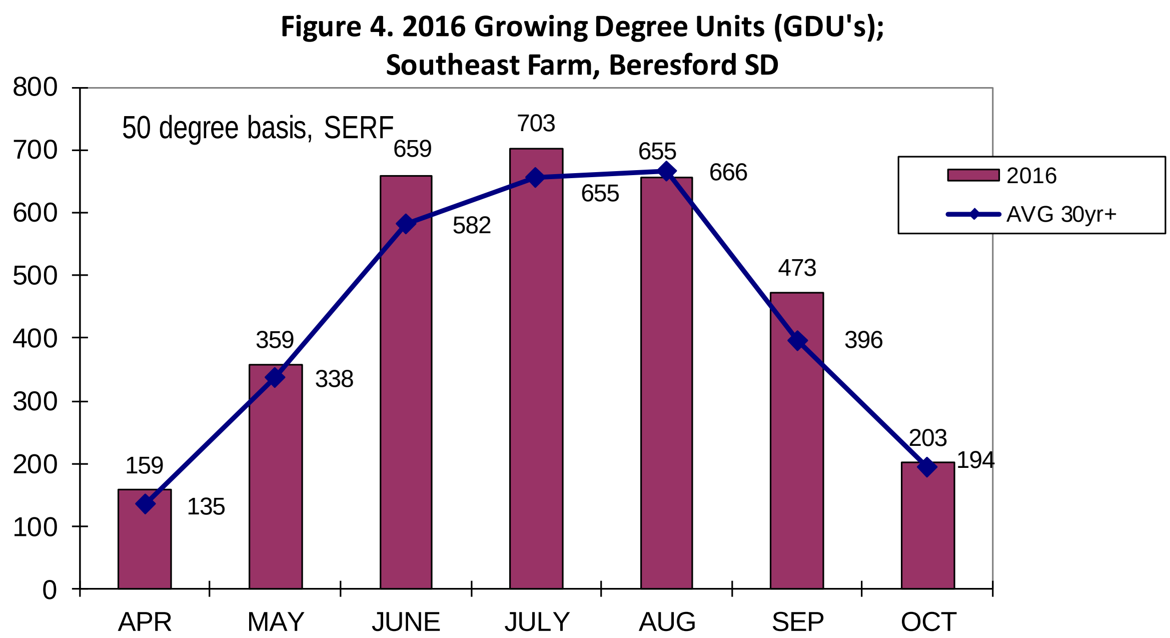


Figure 4. 2016 Growing Degree Units (GDU's);
Southeast Farm, Beresford SD
50 degree basis, SERF
800
700
600
500
400
300
200
100
0
159
135
359
338
659
582
703
655
655
666
473
396
203
194
APR
MAY
JUNE
JULY
AUG
SEP
OCT
2016
AVG 30yr+

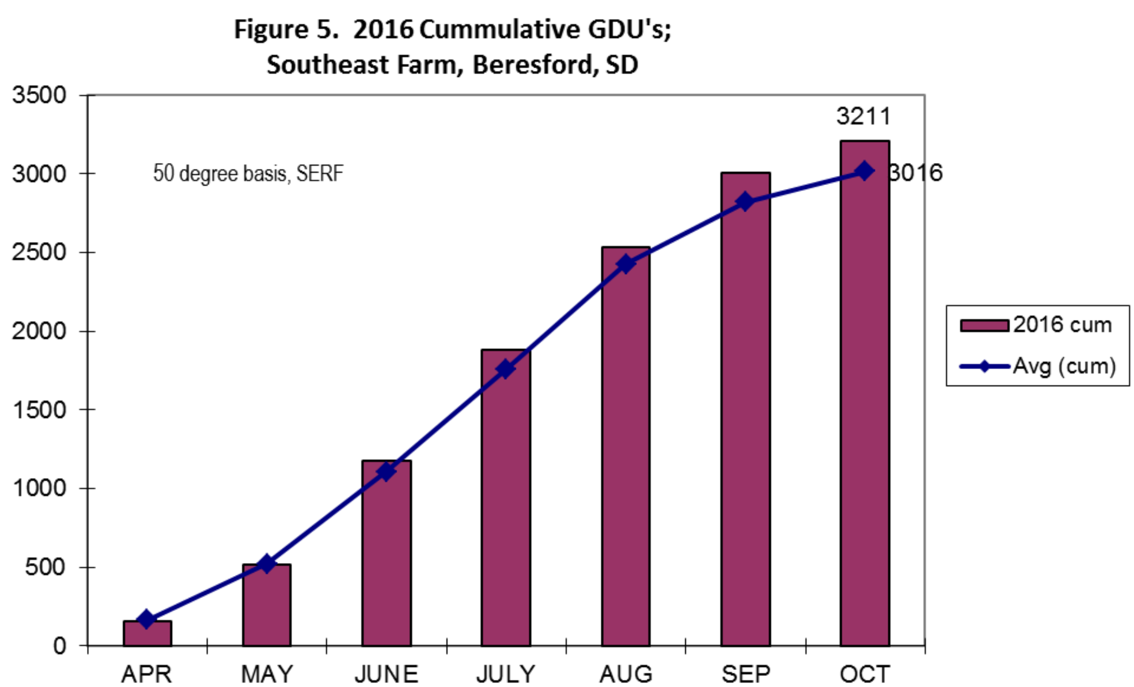


Figure 5. 2016 Cummulative GDU's;
Southeast Farm, Beresford, SD
50 degree basis, SERF
3500
3000
2500
2000
1500
1000
500
0
3211
3016
APR
MAY
JUNE
JULY
AUG
SEP
OCT
2016 cum
Avg (cum)

Figure 6. 2016 Growing Season
Rainfall vs. Evaporation
Southeast Farm

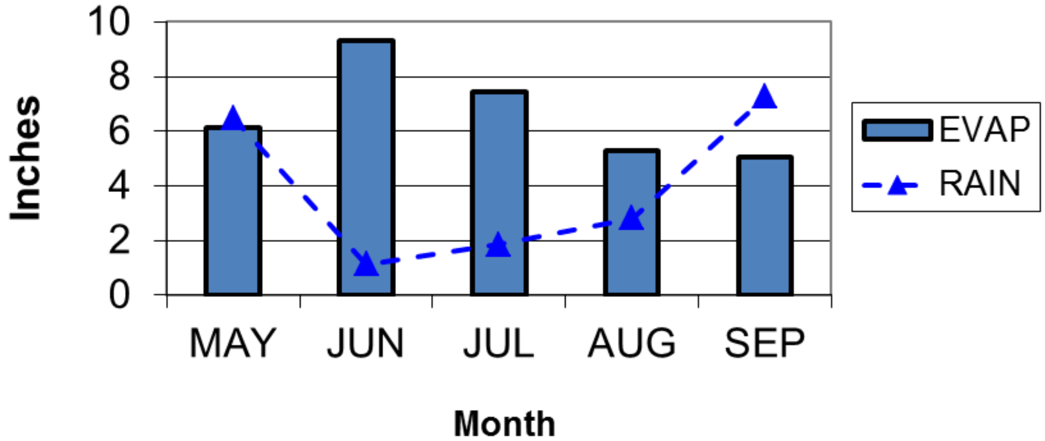
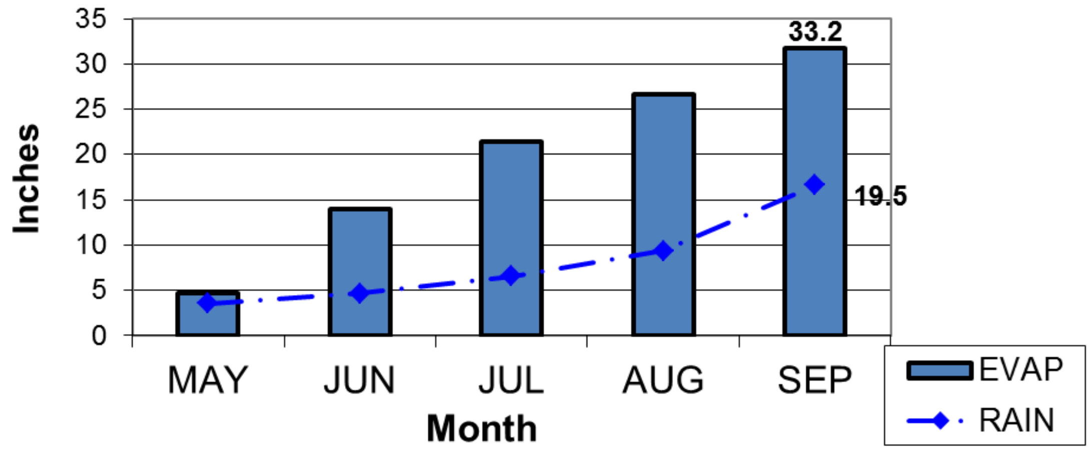


Figure 7. 2016 Growing Season
Cumulative Rainfall vs. Evaporation
Southeast Farm



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Evaluation of Multi-Line Seeding for Corn and Soybeans in Southeastern South Dakota – Year 4

Peter Sexton*, Douglas Prairie,
and Barry Anderson

INTRODUCTION

This report very briefly reviews our fourth season of trials looking at variable-line seeding of corn and soybeans using a multi-hybrid planter. In the first season (2013) at the Tripp and Beresford sites we found on average a 5 bushel per acre yield gain with variable line planting in corn and a 3 bushel per acre yield gain in soybeans. In the second year of the study, we again found a 6 bushel yield advantage with corn with the right pairing of lines, but no advantage with corn or soybeans if the lines didn't fit well. In the third year of the study we had above average rainfall in August and did not see a yield difference from multi-line planting.

The basic logic behind this approach is that given our rainfall distribution (which peaks in May and June) versus the water requirements of corn and soybean crops (which peak in August) there is a good chance that in the same field in the same season the lowland parts of the field may be yield limited by excess moisture early in the season, while the upland positions on the landscape will be yield limited by drought stress in late July and August. It seems logical that gains in productivity within a field might be achieved by using lines with a more horizontal root profile and tolerance to wet conditions in lowland portions of the landscape, and switching to lines with a more vertical root profile and resistance to drought conditions in the upland portions of the landscape. The primary objective of this project is to make an initial evaluation of improvements in grain yield for corn and soybeans grown with a multi-line planting system versus planting a single line across the landscape.

METHODS

This project was partially supported by the South Dakota Soybean Research and Promotion Council. Field maps were developed for each test site by personnel from SDSU. Agronomists from Pioneer Hi-Bred selected the lines to be used in the upper and lower landscape positions for the study. The project involved two corn and two soybean lines, each line selected for adaptation to either upland or lowland conditions. A variable rate seeding treatment was also included which involved a higher seed rate for corn under lowland (higher moisture) parts of the field and lower seed rate on upper parts of the field; for soybeans the rates tested were the opposite with a reduced seed rate in the lower parts of the field (to avoid white mold)

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and a higher seed rate in the upper part of the field (Table 1). Plots were 15 feet wide for corn and 30 feet wide for soybeans and ran the length of the field in each case (800 feet to 1700 feet). Corn was planted on 26 May 2016; the soybean trials were planted on 7 June and 2 June 2016, at the research farm and at our cooperator's field, respectively. Yield was measured directly using a weigh wagon to determine weight harvested from each plot. Data was analyzed using standard ANOVA with Proc GLM in SAS statistical software. There was a significant treatment by site interaction for yield in the soybean trials, so the two soybean sites were analyzed separately.

Table 1. Location, lines used, and seed rates for corn and soybean trials conducted in southeast South Dakota to evaluate use of a multi-hybrid planter for these crops in the 2015 growing season. The standard seed rate for corn was 32,000 seeds per acre; and for soybeans it was 150,000 seeds per acre.

Crop	Cooperator Location	Upland Line	Lowland Line	Variable Seed Rates	Number of Replications
Corn	SDSU Southeast Farm	P0339AMXT	P0157AMX	32/40; 28/36	5
Soybean	Beresford	P24T93R	P25T51R	115/185	3
Soybean	SDSU Southeast Farm	P24T93R	P25T51R	115/185	3

RESULTS

Corn. This trial has been run for four seasons with variations in lines and planters used. In the first two seasons the trial was run there was an average of a 5 to 6 bushel per acre yield advantage ($P<0.10$) with variable line seeding of corn hybrids versus when lines were sole-seeded across the landscape. However, in the 2015 season there was no significant effect of multi-hybrid planting observed on corn yield. This year (2016), again there was no signficant effect of multi-hybrid planting on yield (Table 2). There was a trend for about 5 to 10 bu/ac greater yield with variable rate seeding. The 2016 season was marked by an extremely wet spring, and the lowland did have significantly better stand in wetter parts of the field than did the "upland" line. However, this was not enough to create a yield advantage for multi-line seeding. There was some drier weather in late July and early August with rain arriving again in mid-August, but given the reserve of moisture from the wet spring, there was no substantial drought stress in this particular field in 2016. The reserve of moisture may have equally benefitted both lines during seed-filling and lessened the benefit of multi-hybrid planting. The other part of this equation is line selection and perhaps a line with higher yield potential in the lowland part of the field would have shown a better response.

Soybeans. Previous work with mult-line planting with soybeans has also shown mixed results depending on line selection and weather during seed-filling. We saw a positive result in 2013 (3 bu/ac gain with multi-line seeding), no differences in 2014 (perhaps due to line selection), and no differences in 2015 (presumably due to above average rainfall in August of that year). In this year's trials with soybeans, there was a significant benefit to multi-line seeding at the Southeast Research Farm, but not at our nearby cooperator's field. The field at the Southeast Farm had more moisture at planting than did the cooperator's field. This is consistent with the lower plant stand at the Southeast Farm site (about 15 % fewer plants at maturity). The two sites were planted with the same equipment and the same settings for seed rate. In the more difficult Southeast Farm site, multi-line seeding showed improved yield over P24T93R by itself ($P < 0.10$), and a trend for greater yield than P25T51R by itself ($P < 0.25$) (Table 3). P25T51R, which has more tolerance to wet conditions, outyielded P24T93R across the field at this site. However, multi-line seeding and including P24T93R in the upland positions showed a definite trend for greater yield ($P<0.25$) than planting P25T51R by itself. The lowland line (P25T51R) showed a trend for better plant stand in lowland positions at both sites.

At the off-station site, in our cooperator's field, yield differences were not significant ($P > 0.20$) for all the treatments. This site had better planting conditions and was a tilled field and showed better stands although yields were similar at the end of the season.

SUMMARY

In summary, after four seasons of experiments with multi-line planting, we found significant ($P < 0.10$) yield benefits about half the time, and no yield loss in any case. For corn, the better combinations we tried showed about an 8 bu/ac yield gain; for soybeans it was about 3 bu/ac. However, half the time we didn't see a yield improvement with multi-line planting. While the logic behind multi-line planting is compelling, there are multiple parts to this equation to consider in order to capture the potential benefits that are there. First, on the planting side, one needs to be able to map the different management zones in the field and know where their boundaries are; second, one needs high-yielding lines that have strengths that match those particular zones; third, one needs equipment that accurately and precisely switches between lines on the go; fourth, the season and the weather need to fall within the range of your expectations. If the weather is outside the range of your expectations or planning (for good or for ill) then your line selection won't match conditions and you probably won't see a yield advantage with multi-line planting. For example, in 2015 conditions during seed-filling were very good with well above average precipitation in July and August which came as well-dispersed rains – in this case everything did well and we didn't see an advantage to multi-line planting. On the other hand in 2014, we had record-setting precipitation in June, which completely flooded the better part of one of our research fields for more than a week – obviously nothing was going to perform well in those circumstances.

Looking at this equation for successful multi-line planting, the mapping and the equipment sides of this formula are pretty well worked out, and with good management they should not be a limitation. Looking at the weather, average temperature and rainfall for a given location can be calculated and is helpful, but as we all know the climate in any particular year is uncertain. For this reason, because one doesn't know 100 % what the weather will do, all the lines selected should have good yield potential. It may be that your usual bad spot will turn out to be the best spot in the field if the weather is particularly suited for it (either wet or dry as the case may be). Choose among high-yielding lines for the particular strengths you think a particular management zone will need. This is probably where the future of multi-line planting is at this point – with the seed companies and the plant breeders. If they can find it within their resources and business plans to develop high-yielding lines suited for particular stress environments and identify them for farmers, then there will be a large potential for this technology in the future. If not, then I think the benefits will still be there for matching lines to a given field environment, but the benefits will be more incremental and scattered.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the South Dakota Soybean Research and Promotion Council for supporting this project. The authors would also like to recognize Mr. Gordon Andersen and Mr. Matt Loewe for being willing to put trials on their operations and for their work in implementing these trials. The efforts of the crew at the SDSU Southeast Research Farm were critical for the successful completion of this project.

Table 2. Stand, moisture, test weight, 100-seed weight, and yield for corn hybrids P0339AMXT, and P0157AMX, seeded in upland, and lowland positions, respectively, across the landscape and also by themselves as a check in a trial conducted at the SDSU Southeast Research Farm to test multi-line seeding in 2016.

Upland / Lowland	Upland / Lowland Seed Rate	Upland Stand	Lowland Stand	Moisture	Test Wt.	100-Seed Wt.	Yield
	(1000's/ac)	(plants/ac)	(plants/ac)	(%)	(lb/bu)	(g)	(bu/ac)
P03/P01	32/40	30250	36058	16.3	57.2	30.5	206
P03/P01	28/36	28556	34122	16	57.8	30.4	200
P03/P01	32/32	30492	30250	15.9	57.4	31.5	196
P03/P03	32/32	31460	29524	16	57.6	29.5	195
P01/P01	32/32	30734	31702	16.2	57.4	29.6	193
Mean		*30298*	*32331*	*16.1*	*57.5*	*30.3*	*198*
CV (%)		*9.2*	*4.7*	*2.4*	*1.3*	*6.3*	*4.3*
LSD (0.05)		*NS*	*1812*	*NS*	*NS*	*NS*	*NS*

Table 3. Stand, moisture, test weight, 100-seed weight, and yield for soybean lines P24T93R, and P25T51R, seeded in upland and lowland positions, respectively, across the landscape and also by themselves across landscape in two trials conducted to test multi-line seeding in southeastern South Dakota in 2016. Yield differences were statistically significant at the Southeast Research Farm, but not in the off-station trial.

Line	Upland / Lowland Seed Rate	Lowland Stand	Upland Stand	Moisture	Test Wt.	100-Seed Wt.	Yield
	(1000's/ac)	(plants/ac)	(plants/ac)	(%)	(lb/bu)	(g)	(bu/ac)
Southeast Farm:							
P24/P25	150/150	90024	97445	12.7	58.0	16.2	65.3
P24/P25	185/115	76956	119548	12.8	58.0	15.9	65.0
P25T51R	150/150	101156	91960	12.8	57.9	16.0	63.2
P24T93R	150/150	94219	96155	12.6	57.5	15.3	60.2
	Mean	*90895*	*100381*	*12.7*	*57.8*	*15.8*	*63.3*
	CV (%)	*4.7*	*9.2*	*0.6*	*0.7*	*3.1*	*2.7*
	LSD (0.10)	*7367*	*NS*	*0.1*	*NS*	*NS*	*2.9*
Beresford (off-station trial):							
P24T93R	150/150	110594	110110	12.6	56.6	15.0	60.0
P24/P25	185/115	86636	146007	12.8	56.4	15.2	58.1
P25T51R	150/150	125356	96800	12.8	55.9	15.8	56.8
P24/P25	150/150	120597	127211	12.7	56.4	15.3	56.8
	Mean	*110796*	*120032*	*12.7*	*56.3*	*15.3*	*57.9*
	CV (%)	*3.7*	*9.7*	*2.3*	*0.8*	*1.4*	*3.3*
	LSD (0.10)	*6487*	*18493*	*NS*	*NS*	*0.3*	*NS*

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Winter Canola Variety Evaluation – SDSU Southeast Research Farm

Peter Sexton*, Mike Stamm, Sara Berg,
Doug Johnson, and Duane Auch

INTRODUCTION

This trial is an evaluation of winter canola lines for their potential for production in southeastern South Dakota. Winter canola would add much to our rotation if we could develop a reliable production system for this crop. As a broadleaf winter annual and as a *Brassica*, we currently do not have anything like it in our cropping system – which means it would add diversity to our systems which would help with disease and pest control. It matures relatively early, which creates more options for cover crops and grazing, and perhaps somewhere in the future for double cropping. Southern South Dakota does not have a history of canola production because it is on the warm side during the summer for production of spring canola, and the winters are a challenge for winter canola to survive. Nevertheless, we think there is potential for winter canola in our region and are working to develop a production system suitable for our environment. This is the first of what we hope will be a series of reports on this endeavor.

METHODS

Plots were established by direct seeding into oat stubble on 4 Sept 2015 using a small plot drill set to a depth of 0.5”. Plot size was 5 feet by 20 feet. The trial was organized as a randomized complete block design with three (3) replications. Open-pollinated lines were in one block, and hybrid lines were in another block in the field. Oats were seeded with the canola at a seed rate of 20 lb per acre to help provide cover over the winter. Nitrogen was applied as urea at a rate of 115 lbs. N/ac on 13 April, 2016. All the lines overwintered. Plots were desiccated with an application of diquat on 28 June 2016, and harvested with a small plot combine on 1 July 2016. Grain samples were screened, and weight and moisture determined for each plot. Yield data was subjected to standard ANOVA using PROC GLM in SAS statistical software.

RESULTS

The better lines in this trial averaged on the order of 2400 to 2600 lb per acre in this initial trial, with the hybrid lines averaging 11 % greater yield than the open-pollinated lines (Tables 1 and 2). The open-pollinated lines showed a trend for a little better over-wintering ability with an average plant stand of 2.64 plants per square foot versus 2.17 plants per square foot for the hybrid lines. The results of this trial are promising enough that we hope to expand our work with winter canola in the future and develop ways, such as inter-seeding oats with

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the canola, to improve its over-wintering ability, and thus have stronger stands and sufficient yield to be competitive as a cash crop in our environment.

ACKNOWLEDGEMENT

The authors appreciate the contributions of the South Dakota Agricultural Experiment Station to support this project.

Table 1. Moisture, stand at maturity, and seed yield from a winter canola variety trial with hybrid lines conducted at the SDSU Southeast Research Farm in 2016. Plots were planted on 4 Sept. 2015 and harvested on 1 July 2016.

Line	**Moisture**	**Stand**	**Yield**
(hybrids)	(%)	(plt/ft^2)	(lb/ac)
DK Imiron CL	13.1	2.57	2685
DK Imistar CL	14.5	3.53	2586
DK Severnyi	13.9	3.29	2583
Hornet	14.8	2.10	2511
46W94	13.4	3.14	2458
DK Sensei	9.9	1.62	2439
Einstein	15.2	2.05	2436
Thure	12.7	1.34	2425
Edimax CL	14.4	3.00	2329
Helix	18.3	2.86	2286
Hekip	16.2	2.00	2212
Mercedes	15.7	2.48	2189
Popular	14.7	1.86	2157
DL14001RR	13.6	2.19	2150
Reflex CL	13.0	1.62	2134
Inspiration	13.8	1.57	1913
WRH458	15.3	1.33	1737
PX112	16.8	1.29	1641
Exp1302	13.5	1.34	1536
Mean	*14.3*	*2.17*	*2232*
CV (%)	*18.3*	*41.6*	*14.1*
LSD (0.05)	*NS*	*1.49*	*522*

Table 2. Moisture, stand at maturity, and seed yield from a winter canola variety trial with open-pollinated lines conducted at the SDSU Southeast Research Farm in 2016. Plots were planted on 4 Sept. 2015 and harvested on 1 July 2016.

Line	**Moisture**	**Stand**	**Yield**
(OP materials)	(%)	(plt/ft^2)	(lb/ac)
Star 915W	11.1	3.05	2583
Riley	13.7	2.53	2352
DKW46-15	9.9	2.86	2339
Quartz	14.3	4.77	2226
KSUR1211	9.6	2.57	2216
DKW47-15	11.4	3.72	2211
Kadore	10.0	3.24	2193
HyCLASS225W	9.2	1.76	2067
HyCLASS220W	11.8	1.81	2031
Claremore	12.0	1.67	2028
DKW44-10	16.1	2.72	1989
KSR07363	11.1	2.19	1979
HyCLASS125W	13.0	2.86	1949
KS4506	15.1	3.14	1933
DKW41-10	15.5	1.38	1908
Wichita	8.4	2.33	1884
HyCLASS115W	11.6	6.10	1748
15.UI.WC.1	16.4	1.81	1708
15.UI.WC.05633	20.1	2.38	1662
Sumner	11.0	1.52	1606
DKW45-25	12.4	1.95	1503
Mean	*12.6*	*2.64*	*2005*
CV (%)	*20.6*	*44.5*	*26.0*
LSD (0.05)	*2.0*	*1.97*	*NS*

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Evaluation of Row Spacing in Soybeans in the 2015 and 2016 Growing Seasons at the Southeast Farm

Peter Sexton*, Garold Williamson, Doug Johnson, and Brad Rops

INTRODUCTION

This report summarizes data from two recent row spacing studies done with soybeans at the Southeast Farm, one in 2016 and another larger study from 2015. In 2016, we had a very wet spring which delayed soybean planting. Under these conditions, one would expect a benefit from narrower row spacing both in terms of yield and in weed control. To observe the actual impact of narrower rows on yield and weed incidence, a large-plot trial was established comparing soybeans planted in 30” rows to soybeans drilled in 7.5” row spacing.

In the previous season (2015), a trial was conducted comparing twin row and single row seeding of soybeans on 30” centers across a range of populations (35,000 to 210,000 seeds per acre) and a drilled treatment was also included at a single population (140,000 seeds per acre) for further comparison. Each of these plots was split with half receiving a fungicide application at R3 and half not – so the 2015 trial included seed rate, row spacing, and fungicide treatments as variables.

METHODS

The 2016 trial was planted on 20 June 2016, and consisted of the following treatments: 30” row width seeded at 160, 000 seeds/acre; drilled soybeans seeded at a rate of 160,000 seeds/acre; and drilled soybeans seeded at a rate of 200,000 seeds/acre. Plots were 30 feet wide and ran for a length of 500 feet. Plots were visually rated for percent control of grass and broadleaf weeds just before harvest. This was done by two people and the scores averaged and the data arc-sine transformed before being subject to statistical analysis. Yield samples were taken by combining the center 20’ from each plot and weighing the seed for each plot in a weigh-wagon.

The 2015 trial was planted on 1 June 2015. Main plots were 15 feet (6 rows) wide by 200 feet in length and were laid out in a randomized complete block design with four replications. A foliar application of ‘Headline’ fungicide was made at the R3 growth stage in 90 strips across each replication in a strip-split plot design. Plots were end trimmed 10’ at harvest, and the middle four rows of each plot were combined for whole plot yield.

All data were analyzed with standard ANOVA using the Proc GLM routine in SAS statistical software. Yield was regressed against stand at

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harvest using individual plot data, rather than treatment means, in the 2015 study because of large plot to plot variability in stand in that particular field.

RESULTS

In the 2016 trial soybean yields were 4 bu/ac higher when drilled in 7.5” rows versus when they were planted in 30” rows (Table 1). There was no difference between the high and low seed rates for the drilled soybeans. There was a trend for slightly greater weed incidence in the 30” rows, but differences in weed control between treatments were not statistically significant. The field was worked before planting. The only herbicide applied in this trial was glyphosate applied as a single post-emergence application.

In the 2015 trial with a range of seed rates in both single and twin rows, seed rate showed a strong effect on yield as expected, while use of twin rows and fungicide application both showed trends for about a 3 bu/ac greater yield but differences were not statistically significant for these latter two effects (Table 2). Regressing yield data from individual plots against stand at maturity showed that yield increased up to a final stand of approximately 114,000 plants per acre and then plateaued at stand density greater than that. Assuming a value of $10 per bushel price for soybeans, and a cost of $50 a bag for seed and 20 % seed mortality, the predicted economic optimum final stand in this study would be at 107,000 plants per acre at maturity – which would mean an initial seed rate of 134,000 seeds per acre.

The common theme between these two trials was the trend for slightly greater yield (about 3 to 4 bu/ac) with narrower row spacing, and the lack of yield response to population above 114,000 plants per acre. This is consistent with previous work on soybean seed rates conducted at the Southeast Farm in 2013 where yield plateaued at approximately 100,000 plants per acre. Assuming a target final stand of 110,000 plants per acre and that 80 % of the seeds planted survive to make a plant, a seed rate of 138,000 seeds per acre would provide enough of a stand to maximize yield in this environment.

ACKNOWLEDGEMENTS

The authors appreciate the contributions of the South Dakota Soybean Research and Promotion Council and the South Dakota Agricultural Experiment Station to support this project.

Table 1. Stand, grain moisture, test weight, 100-seed weight, grain yield, grass and broadleaf percent control for late-seeded soybeans planted 20 June 2016 comparing 30" rows versus drilled at two different seed rates.

Treatment	Stand	Moisture	Test Wt.	100-Seed Wt.	Yield	Grass Weed Control	Broadleaf Weed Control
	(plants/ac)	(%)	(lb/bu)	(g)	(bu/ac)	(%)	(%)
Drilled - Low Pop.	128938	12.2	55.7	17.8	60.7	95.2	89.0
Drilled - High Pop.	155654	12.3	55.6	18.1	60.5	97.2	86.0
30" Rows	109771	12.1	55.7	18.1	56.7	94.4	84.0
Mean	*131454*	*12.2*	*55.7*	*18.0*	*59.3*	*95.6*	*86.3*
CV (%)	*11.7*	*1.3*	*1.0*	*2.3*	*2.3*	*12.0*	*9.8*
LSD (0.05)	*22491*	*NS*	*NS*	*NS*	*2.0*	*NS*	*NS*

Table 2. Yield, stand at harvest, lodging score, moisture content, test wt., and 100-seed weight for soybeans sown across a range of seed rates in single and twin rows on 1 June 2015 at the SDSU Southeast Research Farm in Beresford, SD. The fungicide treatment (‘Headline’) was applied at the R3 stage. There were no significant treatment interaction effects on yield in this study.

ROW	Seed Rate	YIELD	STAND	LODGE	Moisture	TEST WT.	100-SEED WT.
	(seeds/ac)	(bu/ac)	(plants/ac)	(0 to 5)	(%)	(lb/bu)	(g)
Single	35	28.5	24684	1.9	10.8	55.7	17.7
Twin	35	40.3	39204	1.8	8.7	59.9	17.0
Single	70	47.9	61468	1.6	9.0	58.2	17.1
Twin	70	51.7	71148	2.6	8.4	60.6	17.2
Single	105	52.0	84700	1.5	9.2	57.8	17.4
Twin	105	53.7	98252	1.4	9.0	58.7	17.2
Single	140	54.7	99704	2.0	9.8	56.4	16.9
Twin	140	54.0	135036	1.8	9.7	56.9	17.0
Single	175	60.7	166496	1.7	9.7	56.8	17.9
Twin	175	59.7	164076	1.9	9.3	57.9	17.7
Single	210	60.6	155364	1.9	10.3	55.5	17.4
Twin	210	59.3	194568	2.3	10.9	54.5	18.1
Single	No Fungicide	49.9	91476	1.6	9.6	56.9	17.1
Single	+ Fungicide	51.6	105996	1.9	10.0	56.5	17.7
Twin	No Fungicide	50.6	112772	1.6	9.3	58.1	16.7
Twin	+ Fungicide	55.7	121323	2.3	9.4	58.0	18.0
Both	No Fungicide	50.2	102124	1.6	9.4	57.5	16.9
Both	+ Fungicide	53.6	113659	2.1	9.7	57.3	17.9
	mean	*51.9*	*107892*	*1.9*	*9.6*	*57.4*	*17.4*
	CV (%)	*18.4*	*25.9*	*42.3*	*17.6*	*6.3*	*3.1*
Seed Rate	*P-value*	*<0.01*	*<0.01*	*NS*	*0.13*	*0.08*	*< 0.01*
Fungicide	*P-value*	*0.13*	*0.09*	*< 0.01*	*NS*	*NS*	*< 0.01*
Row	*P-value*	*NS*	*<0.01*	*NS*	*NS*	*0.12*	*NS*

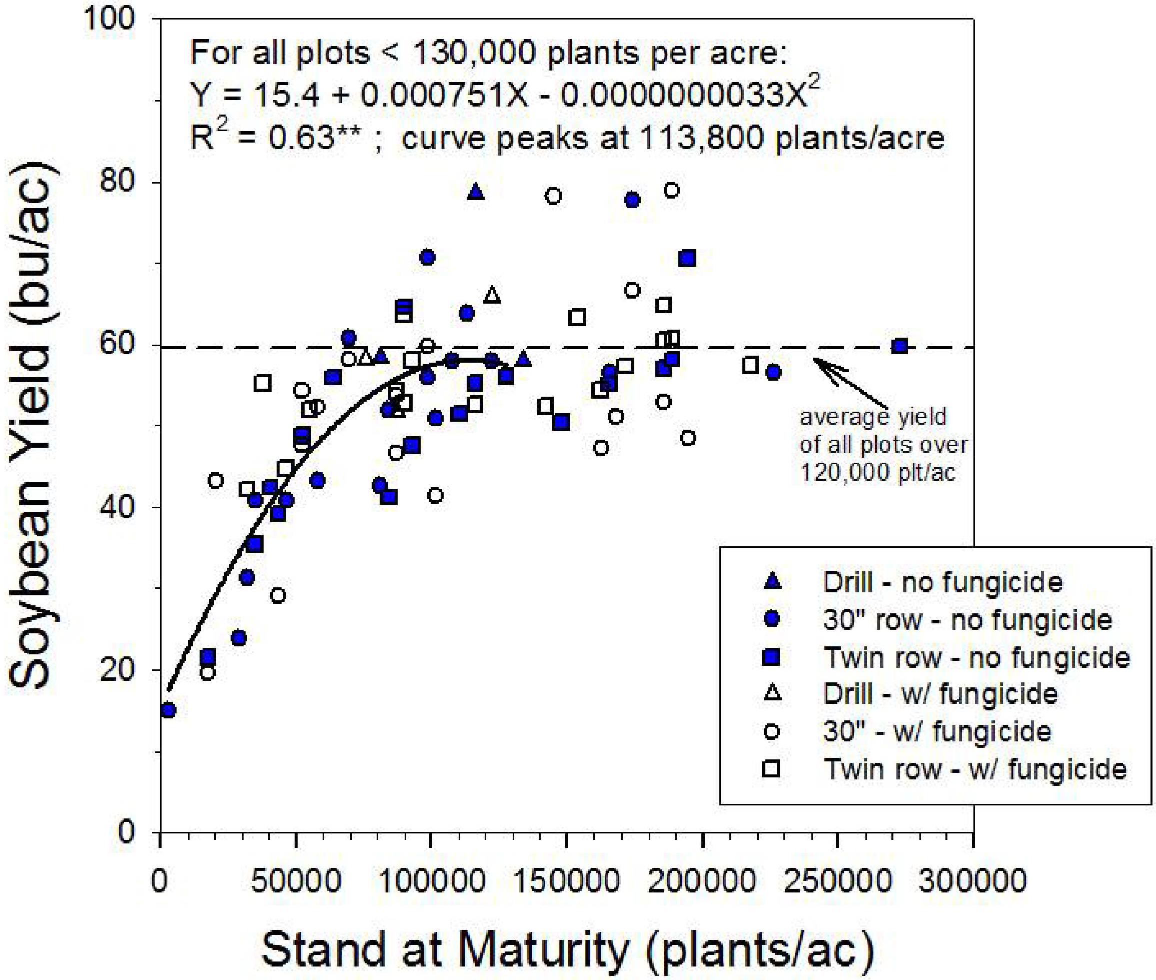

Fig. 1. Soybean grain yield versus stand at maturity across a range of seed rates for single and twin row spacings on 30" centers at the SDSU Southeast Research Farm in Beresford, SD in the 2015 growing season. A set of drilled plots was also included in the study and this data is shown as well. Each point corresponds to an individual plot yield and stand.

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Alfalfa Variety Trial at the Southeast Research Farm

Sara Berg, Karla Hernandez,
and Peter Sexton*

INTRODUCTION

Alfalfa is an important crop in ruminant nutrition. The following is a report on yields observed in the establishment year of an alfalfa variety trial conducted at the SDSU Southeast Research Farm in the 2016 season. This is a small plot study with 21 lines. Plots were harvested three times – 22 June, 28 July, and 25 August, 2016. The year was marked by an unusually wet spring, followed by a period of moderate drought stress in late July to mid August. Leafhopper pressure developed over time, and the plots were sprayed for leafhoppers on 20 July, 2016. This trial will be continued for two more years.

METHODS

These plots were laid out in a randomized complete block design with four replications. Plot size is 4 foot by 25 foot. Plots were planted with a small-plot Brillion Seeder on 14 April, 2016 at a seed rate of 15 lb/ac. For weed control, Pursuit was applied at 4 oz/ac on 7 June, 2016; Butyrac 200 was applied at 2 qt/ac on 6 August, 2016. For leafhopper control, Mustang Maxx was applied at a rate of 4 oz/ac on 20 July, 2016. Plots were end-trimmed to a 20’ length immediately before harvest and then whole plot yields were taken using a forage harvester (Model SMW-SCH-48; Swift Machine & Welding, Swift Current, Saskatchewan, Canada). Subsamples of fresh material were weighed and dried at 140˚ F to determine percent moisture. All yield data are presented on a dry weight basis. Data was subjected to standard ANOVA using SAS statistical software.

RESULTS

Yield data for each cutting and summed over the course of the season is given in Table 1. Average yield for the plots was 4590 lb per acre on a dry matter basis, ranging from 3899 to 5164 lb/ac. These plots will be maintained and yield data collected for the next two growing seasons.

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Table 1. Forage yield on a dry matter basis during the establishment year for 21 lines of alfalfa evaluated at the SDSU Southeast Research Farm in the 2016 season. Data are based on whole plot (4 by 20') yields in a replicated trial. The leafhopper rating is on a 0 to 10 scale, with 10 being no damage and 0 being extreme damage. The leafhopper rating was made on 22 June, 2016. The plots were planted on 14 April, and harvest dates were 22 June, 28 July, and 25 August, 2016.

Line	Source	First Cut	Second Cut	Third Cut	Total	Leafhopper Rating
		(lb/ac)	(lb/ac)	(lb/ac)	(lb/ac)	(0 to 10)
HybriForce-3420/Wet	Dairyland	2045	1690	1430	5164	7.5
8420	Wilbur Ellis Company	1951	1790	1376	5118	7.3
4H400	Mycogen	1974	1531	1413	4919	8.0
FSG 423ST	Farm Science Genetics	2039	1516	1328	4883	7.0
AFXH143146	Dairyland	2047	1492	1331	4869	7.8
GA-409	Preferred Alfalfa Genetics	1910	1662	1261	4834	7.5
GA-497 HD	Preferred Alfalfa Genetics	1810	1607	1384	4802	7.0
Leyenda	Legend Seeds	1808	1465	1494	4766	6.5
AFXH144110	Dairyland	1573	1595	1558	4727	8.0
FSG 415 BR	Farm Science Genetics	1753	1410	1556	4719	7.5
8450	Wilbur Ellis Company	1553	1550	1502	4604	7.5
Bobolink	Blue River Hybrids	1719	1563	1296	4578	7.8
Robin	Blue River Hybrids	1307	1642	1619	4569	7.5
FSG 426	Farm Science Genetics	1285	1638	1563	4486	6.8
Mustang 420+	Mustang Seeds	1702	1492	1144	4338	7.5
FSG 403LR	Farm Science Genetics	1538	1448	1327	4313	7.3
8444R	Wilbur Ellis Company	1553	1464	1482	4284	6.8
Roadrunner	Blue River Hybrids	1718	1281	1180	4179	6.8
HybriForce-3430	Dairyland	1664	1341	1157	4161	6.8
DG 4210	Dyna-Gro	1220	1465	1232	3916	7.0
Mustang 620 Aph 2	Mustang Seeds	1266	1412	1274	3899	7.3
Mean		*1694*	*1526*	*1377*	*4589*	*7.3*
CV (%)		*20.7*	*13.9*	*16.4*	*10.5*	*11.1*
LSD (0.05)		*496*	*NS*	*NS*	*683*	*NS*
LSD (0.10)		*415*	*NS*	*266*	*570*	*NS*

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Corn Yields Following Grazing of Grass and Broadleaf Cover Crops Under Late Planting Conditions

Peter Sexton[*], Sandeep Kumar, Colin Tobin, Brad Rops, Sara Berg, and Elaine Grings

INTRODUCTION

As interest in cover crops continues to grow, the question is raised about how grazing cover crops may impact yield of the following crop and how does the cover crop blend influence this. In our environment, the typical cropping pattern for grazing cover crops would be small grain, followed by a cover crop which is grazed, followed by corn. To address the questions noted above, a trial was implemented looking at three cover crop blends varying in proportion of grasses in the mix (75:25, 50:50, and 25:75 percent broadleaves and grasses, respectively), along with a no cover crop control treatment. To look at grazing impacts, each of these blocks was split into grazed and ungrazed portions. And to look at impacts on N fertility, the plots were further split in the spring with a +/- N fertilizer treatment and planted to corn. The cover crops were established and grazed in the fall of 2015. The corn crop was planted in 2016; however, the spring of 2016 was extremely wet, and these plots were located in a marginally drained area, so the reader should keep in mind these plots were late-planted for corn production.

METHODS

Three cover crop blends were seeded on 7 August, 2015 on rye stubble (Table 1). Plot size was 30’ x 120’. Each replication was split down the middle into a grazed and ungrazed portion. The grazing treatment was imposed with 19 bred heifers which were allowed access to the plot 2 - 4 November, 2015.

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Table 1. Seed mixes used for cover crop blends varying the ratio of grasses to broadleaves in the mix.

Blend	**Radish**	**Pea**	**Lentil**	**Cowpea**	**Sorg/Sudan**	**Oat**	**Seed Rate**
							(lb/ac)
Low Residue: 25-75 Grass-Broadleaf	3.3	10.5	4.5	2.5	2.5	7	30.3
Equal Blend: 50-50 Grass-Broadleaf	2.0	7.0	3.0	2.5	3.5	36	44.0
High Residue: 25-75 Grass-Broadleaf	0.5	3.5	1.5	2.5	5.0	42	55.0

Corn (P8673AM) was direct seeded on 16 June, 2016. Nitrogen treatments of 0 and 90 lb N per acre (applied pre-emergence as UAN) were imposed in 30' wide strips across each grazing block, making this a split-split plot design. At harvest, the N plots were harvested using a 4-row plot combine (Kincaid model 2065) with a harvest sample of 15' (4 rows) by 25' in length. One of the four replications was dropped from the analysis because of excessively wet conditions in that block. Data were analyzed using standard ANOVA for a split-split plot design with Proc GLM in SAS statistical software.

RESULTS

There were three main treatment effects in this trial:

1) cover crop composition;
2) +/- grazing;
3) +/- N application.

When corn yield data from the trial were subjected to statistical analysis, the following picture unfolds: the effect of N application was statistically significant ($P < 0.05$); the effect of different cover crop blends on corn yield was not as strong, but still seemed to be a factor ($P < 0.10$); the effect of grazing was non-significant ($P = 0.703$). None of the treatments showed a significant impact on plant stand (Table 2). All interactions between the three main effects on yield and stand were non-significant in this trial. There was a weak interaction between grazing and N application effects ($P<0.20$). There was a trend for N response to be greater on plots that were not grazed (25 bu/ac N response) than in plots that were grazed (7 bu/ac N response); however, this interaction was not statistically significant and therefore should be interpreted with caution.

There are several points of interest from this study. First, well managed grazing did not negatively impact yield of the following corn crop even under wet conditions. Second, in our environment, cover crop blends with a strong cool-season broadleaf component tend to increase yield of the following corn crop – in this case by 8 to 17 bu/ac – whereas grass-based cover crop mixes do not help yield of the following corn crop. This is consistent with previous work done at the Southeast Farm where corn consistently yields better following a broadleaf cover crop blend, but not after a grass-based blend. Third, there was a weak trend for the following corn crop to need less N following grazing (i.e. it was less responsive to N fertilizer); however, this effect was not statistically significant in our experiment and therefore this topic needs to be studied further before any conclusions regarding N fertilization can be made. But it is a point that merits further study.

ACKNOWLEDGEMENT

The authors appreciate the contributions of the NRCS and the South Dakota Agricultural Experiment Station to support this project.

Table 2. ANOVA table for main effects and interactions for plant stand and grain yield for grown in a cover crop by grazing by N application study at the Southeast Research Farm in 2016. Analysis is based on a split-split plot design.

Source	Stand P-value	Yield P-value
REP	0.3582	0.6006
Cover Crop (CC)	0.8632	0.0984
Nitrogen (N)	0.2122	0.0105
Grazing (G)	0.7178	0.7037
CC*N	0.9100	0.5498
CC*G	0.8141	0.5830
N*G	0.9461	0.1065
CC*N*G	0.9515	0.5037
CV (%)	11.1	17.9

Table 3. Main effects of cover crop blend, N application, and grazing on plant stand and yield for late-planted corn in a split-split plot experiment conducted at the Southeast Research Farm in Beresford, SD in the 2016 growing season. Interaction effects were non-significant for these variables, so only main effects are shown here.

Treatment	Stand	Yield
	(plants/ac)	(bu/ac)
Cover Crop Blend:		
Equal Blend	25047	113
Broadleaf Blend	23595	104
Grass Blend	24321	101
Control	24948	96
Mean	*24478*	*104*
LSD (0.10)	*NS*	*13*
Nitrogen Effect:		
Nitrogen Fertilizer	Stand	Yield
	(plants/ac)	(bu/ac)
Yes	24873	112
No	24079	96
P-value	*NS*	*
Grazing Effect:		
Grazed	Stand	Yield
	(plants/ac)	(bu/ac)
Yes	24053	106
No	24866	102
P-value	*NS*	*NS*

Note * denotes statistical significance at the 0.05 level

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High Tunnel Berry Production in 2016

Brad Rops*, Peter Sexton,
Ben Brockmueller, Kevin Henseler,
and Doug Johnson

INTRODUCTION

In the spring of 2015, a 20 ft x 48 ft high tunnel was erected at the Southeast Research Farm on a certified organic plot. The preceding crop on the site was alfalfa which was tilled out the fall of 2014. An inch of compost was incorporated in the high tunnel prior to planting. On June 4, 2015 a variety of berries and fruit trees were planted in the high tunnel. The high tunnel plants are watered using a drip tape irrigation system. This report will focus on the berry production in 2016.

METHODS

June bearing strawberries of the variety 'Sparkle' were planted on the west side of the high tunnel. Plants were set in a staggered double row, with 12 inches between rows and 12 inches between plants. Runners quickly filled an area 3 ft x 40 ft, which was then maintained.

Red raspberries of the variety 'Caroline' were planted on the east side of the high tunnel. A single row of canes was planted about 18 inches from the edge of the high tunnel and spaced 12 inches apart in the row.

Both the strawberries and raspberries could be harvested from both sides of the row with the sides of the Gothic arch high tunnel rolled up. No pollinators were introduced this year.

RESULTS AND DISCUSSION

Strawberry harvest began May18 and continued through June 18. Over 80% of the production occurred between May 27 and June 10 with the largest single day harvest occurring June 6. Berries were picked every two or three days. The 2016 yield was 9855 pounds per acre, assuming 18 inch matted rows and 2 feet between rows. Berry size decreased as the season progressed, possibly because irrigation levels were not high enough during peak production.

The first ripe raspberries were picked June 29 from the floricanes (second year canes). Production was steady, but minimal, through July and early August. The most productive period was the last week of August through September, although harvest continued until November 7. The peak harvest day occurred on September 13 and the yield for the season was equivalent to 7755 pounds per acre.

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CONCLUSION

Strawberry production started about 3 weeks ahead of outdoor strawberries. The yield equivalent of 9855 pounds per acre was close to the industry average of 10,000 pounds per acre. There was certainly enough fruit set to exceed that level, but irrigation needs to be monitored more closely to increase fruit size and thereby total yield.

Most of the raspberry production in the year following establishment came from the primocanes (first year canes) during September. Fruit was of excellent quality and production persisted well after the first frost. The per acre yield equivalent of 7755 pounds was well over the industry average of 4000 pounds for red raspberries.

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Long-Term Rotation Study: Observations on Corn and Soybean Yields – 2016 Season

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INTRODUCTION

In 1991 Dale Sorensen initiated a long-term rotation study at the Southeast Farm including comparison of no-till and conventional till under two year (corn-soybean), three year (corn-soybean-small grain) and four year rotations (currently corn-soybean-oat-winter wheat – this rotation has not been constant over the years). The advantages of no-till are many: residue on the surface protects the soil from erosion; it helps to maintain soil organic matter which is important for good tilth; conserves moisture and limits run-off; requires fewer trips across the field. The disadvantages are the loss of tillage as a tool for weed control and slower warming of the soil in the spring. This report provides a brief overview of how the corn and soybean crops yielded under tilled, and no-till, management for the 2016 season in the Southeast Farm's long-term rotation study.

METHODS

As mentioned earlier, this set of plots was first established in 1991. The corn-soybean and corn-soybean-small grain rotation have been consistently followed. The four year rotation initially included alfalfa, then after some years was changed to include peas, and lastly was changed again to include two soybean crops (corn-soybean-winter wheat-soybean), which was the case until the 2013 season. Therefore when the data presented here refers to a four-year rotation, it doesn't mean that a fixed set of crops has been grown in a four-year sequence; it means that corn has been grown once every four years and the other crops in the rotation have varied over the years based on the researcher's interest and judgment at the time. At this point, the four-year rotation is in a corn-soybean-oat-winter wheat sequence.

This trial is laid out in a randomized complete block design with four replications. Plot size is 60 feet by 300 feet. Corn (DK46-36) was planted on June 6, 2016 in 30" rows at a population of 32,000 seeds per acre. Soybeans (P22T39R) were planted on June 8, 2016 in 30" rows at a population of 160,000 seeds per acre.

Yield was measured from the center 30' of corn plots and from the center 20' of soybean plots, running the whole length of the plot; this was combined and the weight determined with a weigh wagon. A sample was kept for determination of moisture and test weight. Data was analyzed for main effects of rotation and tillage on yield using Proc GLM in SAS statistical software.

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Except for soybean stand at harvest, there was no significant rotation by tillage interactions observed this year in either the corn or soybean data sets.

RESULTS

Corn Yields. There was no significant treatment effect on corn yield in this trial in the 2016 season (Table1). The overall average yield for the trial was 189 bu/ac. There was a trend for no-till to yield a little better than conventional till in the two year rotation, but not in the plots with three and four year rotations. Contrary to previous years, the data did not show a corn yield benefit from a longer rotation in 2016. This season was marked by an extremely wet spring which hampered field operations – portions of some plots did not get planted due to wet conditions in low pockets, and some portions were marginal for too much moisture at planting which created variability in the data. Also, given the extremely wet spring conditions, it may have been that the plots in the longer rotation had more moisture in the spring which in these circumstances did not benefit yield.

Soybean Yields. Soybean yields averaged 55.8 bu/ac in this trial with the data showing a significant yield improvement with a longer rotation (Table 2). On average, yields increased from about 51 bu/ac, to 55 bu/ac to 62 bu/ac, going from a 2-year, to a 3-year, to a 4-year rotation, respectively. There was a trend ($P < 0.15$) for the no-till plots to yield more than the tilled plots by about 4 bu/ac on average across all the plots. In 2016, under a 2-year rotation, the data also showed better yield of soybeans under no-till management – it is speculative, but this may be due to greater moisture conservation to support soybean seed-filling in late July and August in these plots.

ACKNOWLEDGEMENT

The authors appreciate the contributions of the South Dakota Agricultural Experiment Station to support this project.

Table 1. Corn yield data from the 2016 season in a long term tillage by rotation study conducted at the SDSU Southeast Research Farm. Tillage treatments are abbreviated as follows: “CT” = conventional tillage; “NT” = no-till. There was no significant tillage by rotation interactions in this data set.

Tillage	Rotation	Stand	Moisture	Test Wt.	100-Seed Wt.	Yield
		(plants/ac)	(%)	(lb/bu)	(g)	(bu/ac)
CT	2-year	30250	15.8	58.5	35.5	189
CT	3-year	29282	15.9	58.1	35.9	199
CT	4-year	28314	16.4	57.9	35.8	186
NT	2-year	30734	16.0	58.2	35.0	200
NT	3-year	30855	16.2	58.1	34.1	186
NT	4-year	30008	16.8	57.4	33.9	172
Mean		*29851*	*16.2*	*58.0*	*35.1*	*189*
CV (%)		*5.7*	*2.1*	*1.0*	*2.4*	*6.1*

Tillage Main Effect:

Tillage	Stand	Moisture	Test Wt.	100-Seed Wt.	Yield
CT	29282	16.0	58.2	35.7	191
NT	30532	16.3	57.9	34.3	186
P-value	*NS*	*NS*	*	*	*NS*

Rotation Main Effect:

Rotation	Stand	Moisture	Test Wt.	100-Seed Wt.	Yield
2-year	30492	15.9	58.4	35.2	194
3-year	30069	16.1	58.1	35.0	193
4-year	29161	16.6	57.6	34.8	179
LSD (0.05)	*NS*	*0.2*	*0.8*	*NS*	*NS*

* Denotes statistical significance at the 0.05 level

Table 2. Soybean yield data from the 2016 season in a long term tillage by rotation study conducted at the SDSU Southeast Research Farm. Tillage treatments are abbreviated as follows: "CT" = conventional tillage; "NT" = no-till. The only significant rotation by tillage interaction in this data set was for soybean stand at harvest – for all the other variables measured the interaction effect was non-significant.

Tillage	Rotation	Stand	Moisture	Test Wt.	100-Seed Wt.	Yield
		(plants/ac)	(%)	(lb/bu)	(g)	(bu/ac)
CT	2-year	110352	11.8	55.1	17.9	46.5
CT	3-year	122150	11.7	55.4	17.9	56.2
CT	4-year	115071	11.8	55.6	17.7	58.4
NT	2-year	128260	12.0	55.1	18.1	54.6
NT	3-year	117612	11.5	55.2	18.0	53.6
NT	4-year	126869	11.6	55.7	17.9	65.4
Mean		*119695*	*11.7*	*55.4*	*17.9*	*55.8*
CV (%)		*5.6*	*1.3*	*1.0*	*1.4*	*9.3*

Tillage Main Effect:

Tillage	Stand	Moisture	Test Wt.	100-Seed Wt.	Yield
	(plants/ac)	(%)	(lb/bu)	(g)	(bu/ac)
CT	115858	11.8	55.4	17.8	53.7
NT	124247	11.7	55.3	18.0	57.9
P-value	*	*	*NS*	*NS*	*NS* [a/]

Rotation Main Effect:

Rotation	Stand	Moisture	Test Wt.	100-Seed Wt.	Yield
	(plants/ac)	(%)	(lb/bu)	(g)	(bu/ac)
2-year	119306	11.9	55.1	18.0	50.6
3-year	119881	11.6	55.3	18.0	54.9
4-year	120970	11.7	55.6	17.8	61.9
LSD (0.05)	*NS*	*NS*	*NS*	*NS*	*9.8*

a/ note: the effect of tillage treatment on soybean yield was significant at the $P < 0.15$ level of significance; Note * and ** denotes statistical significance at the 0.05 and 0.01 levels, respectively

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Evaluation of In-Furrow Application of Fertilizer on No-Till Corn in a High-Residue Environment

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INTRODUCTION

High residue environments protect the soil from erosion and help conserve moisture during drought, but during transition to no-till the extra organic matter can sequester nitrogen (N) and thus increase the need for N fertilizer by a growing corn crop. Once the system reaches equilibrium, extra N is no longer required. In order to evaluate the benefit of in-furrow application of fertilizer, we applied a 1:1:1 ratio of UAN, 10/34/0 and water at a total volume of 5 gallons per acre to deliver 7 lb N and 6 lb of P_2O_5 per acre in-furrow to corn planted in a field that was in its fifth year of no-till production. As a check for placement, we applied the same volume of material to the surface, and included a control with no extra fertilizer applied. There was some interest in putting molasses down in-furrow, so a treatment with molasses added at a rate of 0.8 gallons per acre (15% total volume), along with N and P as listed above, was included in the trial. This application would have diluted nitrogen and phosphorus in the solution.

METHODS

Corn (Channel 207) was planted on May 13, 2016 at a seed rate of 32,000 seeds per acre. The previous crop was oats, which had a strong stand of volunteer oats that grew after the oat grain crop was harvested. The in-furrow materials were applied through a y-splitter mounted behind the seed drop tube on the row unit. Plot size was 15 feet (6 rows) by 320 feet in length. Plots were randomized in a complete block design with five replications. One replication was dropped due to in-field variability and data from four replications were used for analysis. Yield samples were taken from the center four rows of the plot for the full length of the plot using a Kincaid plot combine (model 2065). Stand counts were taken from two points, six feet of row each, after harvest in each plot. Data were analyzed as a RCBD design with the SAS GLM procedure considering all variables as fixed effects.

RESULTS AND DISCUSSION

There were no statistically significant differences among the treatments tested (Table 1). Corn in the plots that received an in-furrow application showed a trend for greater yield, averaging 10 bu/ac higher yield than the control. Addition of molasses to the mixture did not increase grain yield in this trial relative to the UAN:10/34/0: water mixture alone. While the yield response was not statistically significant relative to the control, the observed trend for a yield advantage is consistent with previous work

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done at the Southeast Farm. This is the fourth season at the Southeast Farm that we have had a trial that included an in-furrow fertilizer treatment utilizing 10-34-0 in each of the four years the treatment with 10-34-0 tended to yield more than the control ranging from 5 to 10 bu/ac higher yield with in-furrow application of fertilizer.

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The authors appreciate the contributions of the South Dakota Agricultural Experiment Station to support this project.

Table 1. Stand at harvest, 100 seed wt., and yield for different in-furrow fertilizer treatments applied at planting with corn in a trial conducted at the SDSU Southeast Research Farm in Beresford, SD in 2016. The in-furrow treatment consisted of a 1:1:1 mixture of UAN, 10/34/0, and water applied at a rate of 5 gallons per acre.

Treatment	Stand	100-Seed Wt.	Yield
	(plants/ac)	(g)	(bu/ac)
10-34-0 / UAN	28677	41.2	172
Molasses	30129	38.9	167
Surface	30492	40.9	166
Control	29403	38.4	162
Mean	*29675*	*39.8*	*167*
CV (%)	*8.9*	*4.2*	*4.2*
LSD (0.10)	*NS*	*2.2*	*NS*

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Rye Cover Crop Grown Ahead of Soybeans – 2016 Season – A First Look at Impacts on Soybean Nutrient Uptake

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INTRODUCTION

There has been a debate about the place of cover crops in agriculture over the years, and at times cover crops seem hard to incorporate into agricultural systems due to time and weather. If cover crops can be incorporated into an agricultural system, they can be very beneficial to following crops. Cover crops have many implications within an agricultural system. Cover crops act as cover before the main crop is planted. While the soil is bare, it is exposed to heavy spring rains and wind which makes the soil susceptible to erosion. Cover crops are capable of holding soil in place and reducing soil erosion. Cover crops can also act as an early weed suppressor and weed control before planting. Although there are many implications with using cover crops, it is important that cover crops are managed in a way that will not decrease the yield of the main crop. Cover crops can take up water and nutrients, which under dry conditions can slow or reduce plant emergence. When determining a cover crop, it is important to select a species that is easy to manage, can be easily incorporated into the system, and will not affect the yield of the major crop to be planted.

Rye is a very versatile cover crop. Rye allows for growers to incorporate the cover crop in late summer or in the fall, allowing the crop to overwinter and then have substantial growth in the early spring. In the spring, rye is capable of withstanding heavy rains and may allow for the soil to quickly become aerated because of moisture uptake. This may allow for the grower to potentially plant earlier in the spring. Rye also offers benefits in ways of organic matter and a potential increase in microbial health. Rye is a vigorous cover crop that has substantial growth in the spring allowing for soil cover and weed suppression. Overall the goal of cover crops is to increase the health of soils. Although benefits may not be seen in a short period, it is important that cover crops are considered and incorporated to improve the sustainability of agriculture.

METHODS

The research was conducted using plots on a no-till field at the Southeast Research Farm near Beresford, South Dakota. The plot design was a strip-split design with four replications consisting of 18 plots of soybeans measuring 30 by 43 feet. These plots were divided into strips that were planted with rye and strips that did not have rye. Furthermore, each of these strips was subdivided into plots that were either grazed or

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not grazed. Also, a late-killed rye observation strip was implemented next to the 18 other plots. Treatments consisted of fall grazed with rye, fall grazed without rye, no grazing with rye, and no grazing without rye. Winter Rye ('Rymin') was drilled into the rye plots on corn stubble on November 3, 2015. A target seeding rate of 120 lb per acre of rye was used. Cattle were set out to graze the corn stalks from November 17-27 (19 head on approximately 10 acres). The following spring, the plots were fertilized with MAP at 100 lb/acre. Later that spring, the rye was sprayed out three weeks before planting using a mix of Roundup, Dual, Metribuzen, and Sharpen. In contrast, the late-killed rye observation strip was sprayed out two days before planting using Roundup. On June 8, Pioneer P25T51R soybeans were planted in all plots at a rate of 180,000 seeds per acre. Predatory mites (*Amblyseius andersoni*) were released on June 29 to help prevent insect pressure. Several factors were considered to gather data on soil health and soybean yield following a rye cover crop. On July 24, when the soybeans were between R3 and R4, plant heights, stand counts, and biomass measurements were taken to measure these aspects of plant productivity. Stand counts were recorded by measuring the quantity of plants in 3 feet of row in each plot. Plant heights were measured by recording the height of 3 different plants per plot. Biomass samples were taken from 3 feet of row and oven dried. Soil infiltration rates, rye and corn stalk residue, and soil samples were taken between July 29 and August 2. Two locations per plot were measured for soil infiltration tests. Protocol followed the methods of infiltration testing provided by the NRCS. Each location was infiltrated two times in order to ensure that the soil was at field capacity for the second test. Crop residues were collected from two locations in each plot. Residues were oven dried and weighed. Seven soil samples were taken from each plot and combined to form one composite sample for each plot. Soil samples were sent to Ward Laboratories to undergo Haney Soil testing which measured biological aspects of the soil and nutrient availability. Six days before harvest on October 18, we recorded stand counts, pods per plant measurements, and plant heights. Stand counts were recorded on three feet of row per plot. Pod counts were recorded by counting all pods on three random plants in each plot. Plant heights were measured using 3 random plants per plot. All plots were machine harvested on October 24. Yield measurements and 100 seed weight were collected from each plot. Rye cover crop and grazing effects on soybean yield in the replicated study were compared using a paired t-test. Due to resource limitations, plant tissue samples for each treatment were bulked across replications and analyzed for total nutrient content (N, P, K, S, Ca, Mg, Zn, Mn, B, and Cu).

RESULTS

Grain yield. The yield results are shown in Table 1. From these results we can see that the yields for the rye cover crop versus no cover crop control treatment did not have a significant difference from each other. The yield averages are 64.8 for the rye cover crop plots, and 63.1 for the plots without the cover crop. The nearby observation plot where soybeans were planted into rye that had been sprayed just a few days earlier, yielded 62.8 bu/ac (SE of +/- 1.5 bu/ac). The yield results for the effects of grazing compared to non-grazing are shown in Table 2. In this trial, light grazing of corn stalks did not have a negative impact on yield of the following soybean crop in our environment.

Table 1. Soybean yields from control (no cover crop) and rye cover crop plots from a trial conducted at the Southeast Research Farm in 2016.

Plot Yield (bu/ac)									Average
Rye	65.8	59.8	67.3	66.1	64.5	66.0	59.9	69.5	64.8
No Cover	61.7	64.3	63.	64.1	65.9	60.9	63.1	61.7	63.1
P-value = 0.222, NS									

Table 2. Soybean yields grazed and ungrazed cover crop plots from a trial conducted at the Southeast Research Farm in 2016.

Plot Yield (bu/ac)									Average
Grazed	65.9	60.9	63.1	61.7	64.5	66.0	59.9	69.5	63.9
Non-Grazed	61.7	64.3	63.5	64.1	65.8	59.8	67.3	66.1	64.1
P- value = 0.924, NS									

Biomass and nutrient concentration. Soybean biomass, plant stand, and height at the R3 stage were not affected by the early-killed rye cover crop treatment in the replicated experiment (Table 3). The nearby late-killed rye observation plot was numerically lower by 18 % in biomass relative to the control, and the plants were shorter – suggesting that spraying the rye out later may have slowed soybean growth; however, it should be noted even in these plots, grain yield at the end of the season was numerically within half a bushel of the no cover-crop control treatment at the end of the season (62.8 vs 63.1 bu/ac, respectively).

Effects of the rye cover crop on nutrient uptake were assessed by taking whole-plant (3 feet of row from each plot) and leaf samples (youngest mature leaf, 7 leaves per plot) at the R3 growth stage. Due to limited resources, these samples were bulked across replications and then analyzed for nutrient concentration. At the same time, rye duff samples were collected (two samples of 3 ft^2 from each plot), dried, weighed, bulked across treatments, and analyzed for nutrient content. As an initial means of comparing the effect of the rye cover crop on nutrient concentration, the soybean data points were statistically analyzed across grazing and planting treatments as a completely randomized design. On a whole-plant basis, sulfur concentration appeared to be lower in the plots that had a rye cover crop (Table 4). To a lesser degree, there was a trend for lower Zn and K concentrations in the rye cover crop, but sulfur seemed to be the nutrient most influenced by the rye cover crop. Analysis of soybean leaf nutrient status failed to show any differences, other than Mg which was appeared to be a little higher in the plots that had a rye cover crop (Table 4).

Table 3. Soybean biomass, stand and height at the R3 growth stage in a plus/minus rye cover crop study conducted at the SDSU Southeast Research Farm in 2016. Data from the 'Late-Killed Rye' treatment was from a nearby observation plot and was not included in the statistical analysis, but is provided for the reader's information.

		w/ Rye	No-Rye	*P-value*	Late-Killed Rye
R3 Biomass	(lb/ac)	3101	3164	*NS*	2580
Stand	(plants/ac)	119790	112530	*NS*	121968
Height	(in)	30.3	30.3	*NS*	29.1

Table 4. Nutrient concentration in whole plants, and in youngest mature leaves at the R3 growth stage for soybeans grown in a plus/minus rye cover crop study conducted at the SDSU Southeast Research Farm in 2016. These data are based on limited replications and averaged across grazing treatments, and so should be viewed as preliminary results.

		Whole-Plant Analysis			**R3 Leaf Analysis**		
Nutrient		**With Rye**	**No Rye**	***P-value***	**With Rye**	**No Rye**	***P-value***
N	(%)	3.50	3.53	*NS*	4.24	4.22	*NS*
P	(%)	0.29	0.30	*NS*	0.24	0.25	*NS*
K	(%)	2.47	2.82	*NS*	1.60	1.73	*NS*
S	(%)	0.26	0.33	**	0.27	0.29	*NS*
Ca	(%)	1.20	1.16	*NS*	1.26	1.26	*NS*
Mg	(%)	0.53	0.53	*NS*	0.25	0.21	*
Zn	(ppm)	34.4	40.6	*NS*	38.9	38.8	*NS*
Mn	(ppm)	69.9	72.7	*NS*	121.6	131.5	*NS*
B	(ppm)	50.0	44.5	*NS*	64.8	57.6	*NS*
Cu	(ppm)	10.1	9.7	*NS*	10.1	10.0	*NS*

Note: * and ** denotes statistical significance at the 0.05 and 0.01 levels, respectively.

Multiplying plant nutrient concentration times the shoot weight allows one to calculate nutrient content on a per acre basis as shown in Table 5 (data are averaged across grazing treatments). Again, sulfur content showed a trend to be decreased by the rye cover crop. Where total biomass was virtually the same in the control and early-killed cover crop treatment (within 2 % of each other), S content was numerically 23 % less in the early-killed rye cover crop than in the control. The late-killed rye plot showed total biomass numerically about 18 % lower than the control; however the S content came in numerically 39 % lower than the control. If we look at the N/S ratios for this data, in the control treatment it was 10.7, whereas it was 13.6 in the two rye cover crop treatments. Zinc content also showed a trend to decline in the rye cover plots (numerically 13 % less than the control in the early-killed plots and 36 % less in the late-killed plots, whereas numeric differences in biomass were only 2 %, and 18 % respectively).

It appears that the rye cover crop may be sequestering some S, and perhaps Zn, from the soybean crop (Table 5). There are multiple factors at work here and this is preliminary data, but this is a topic that warrants further research. As noted earlier, the rye treatments and the control plots showed similar grain production (yield averages ranging from 62.8 to 64.1 bu/ac); however, if the plants in the rye cover crop plots were a little short of S or Zn, then we left some yield on the table for the cover crop treatments. Rye as a grass cover crop is well-known to sequester N; since S is largely associated with N within the protein fraction of the plant, it is logical that it would sequester S as well. Soybeans can fix their own N, so that particular nutrient is not a limitation – however, it looks like S is an element that may need to be addressed to maximize productivity with rye cover crops in our environment. This, God willing, will be the topic of continued research in the coming season.

Table 5. Soybean nutrient content for whole shoots taken at the R3 growth stage in a plus/minus rye cover crop study conducted at the SDSU Southeast Research Farm in 2016. These data are based on averages across grazing treatments, and so should be viewed as preliminary results.

		Soybean - Nutrient Content			Rye Duff - Nutrient Content	
		No Rye	w/Rye	Late Rye	Early-killed	Late-killed
Biomass	(lb/ac)	3164	3101	2580	577	1203
N	(lb/ac)	111.5	110.2	87.5	8.48	12.75
P	(lb/ac)	9.5	9.0	7.3	1.81	2.40
K	(lb/ac)	89.5	74.1	67.9	7.49	8.68
S	(lb/ac)	10.5	8.1	6.4	0.84	1.33
Ca	(lb/ac)	36.5	38.0	29.7	2.13	3.38
Mg	(lb/ac)	16.6	16.9	13.2	1.11	1.58
Zn	(lb/ac)	0.128	0.112	0.081	0.0136	0.0228
Mn	(lb/ac)	0.229	0.226	0.167	0.0860	0.1088
B	(lb/ac)	0.141	0.151	0.137	0.0044	0.0080
Cu	(lb/ac)	0.031	0.030	0.029	0.0026	0.0038

SUMMARY

A replicated study was conducted looking at the use of a fall-seeded rye cover crop raised after corn, and corn stalk grazing, on yield of the following soybean crop. Note that grazing pressure was not intense as the cattle were removed early due to cold weather. In the study, the rye was sprayed out 3 weeks ahead of planting; however in a nearby observation plot the rye was allowed to grow and not sprayed out until two days before planting as a point of reference for gathering preliminary data. In this study we observed the following;

1) light grazing of corn stalks had no impact on grain yield of the following soybean crop;

2) the rye cover crop sprayed out three weeks before planting had no negative impact on soybean biomass or yield;

3) the observation plot where rye was sprayed out 2 days before planting appeared to have decreased growth during the season but numerically yielded within half a bushel of the control at the end of the season;

4) analysis of shoot nutrient content suggests that in this trial the rye cover crop may have sequestered S, and perhaps Zn and to a lesser degree K, from the following soybean crop – numerically S content was over 20 % lower in the early-killed rye treatment than in the control, whereas for total biomass these plots were within 2 % of each other on average.

More work needs to be done to measure the impact of a rye cover crop, and timing of when it is sprayed out, on S availability (and perhaps Zn and K) for the following grain crop in order to optimize yields in this system.

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Southeast Research Farm, Beresford SD 57004

Preliminary Study of Cover Crop Effect on Soybean Yield under SCN Pressure

Peter Sexton*, Emmanuel Byamukama, David Karki, Doug Johnson, and Brad Rops

INTRODUCTION

There is very little information on the effect of type of cover crop blend on yield of the following soybean crop in a situation where soybeans follow a small grain. Some members of the Brassicaceae family are known to possess compounds (glucosinolates) which suppress soil pathogens, particularly nematodes. This report provides yield data from a preliminary experiment run where several different cover crop blends were sown after oat harvest in 2015 in a field known to have heavy SCN pressure. Soybeans were then planted in 2016 to gather preliminary data on yield impacts. Because of excessive moisture in this field, planting was delayed in the spring of 2016 and overall yield potential was low.

METHODS

Cover crop blends were planted after oat harvest on 24 August, 2015 (Table 1). Plots were in a randomized complete block design with four replications. Plot size was 15 feet by 80 feet. Soybeans (P16T04R) were direct seeded on 16 June, 2016. The field was planted late due to excessive spring moisture. Plots were harvested using a Kincaid plot combine. Yield, test weight, moisture, and 100-seed wt were determined for each plot.

RESULTS

Yields ranged from 31 to 41 bu/ac in these plots (Table 2). The field was marginally drained and was planted late. The field also had a history of heavy SCN pressure. These two factors would have limited yield potential for the trial. Treatment differences were non-significant; however, there was a trend for soybeans following the mustard and radish blends to yield more than the control (no cover crop) treatment by about 5 to 6 bu/ac. This was a preliminary study with limited data collection and happened to occur in a spring with excessive moisture; nevertheless, given this trend for improved yield with a mustard or radish blend, this effort merits further investigation with more intensive sampling to see how different cover crop blends impact soybean yield in our environment.

ACKNOWLEDGEMENT

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Table 1. List of treatments and seed rates for cover crop blends used in a preliminary study looking at potential effects of different cover crop blends on yield of the following soybean crop in a field with a history of SCN pressure.

Treatment	Seed Rate	Comments
	(lb/ac)	
Control	-----	no cover crop
Mustard Blend	10	50:50 blend of Brassica juncea and Sinapis alba
Radish Blend	10	50:50 blend of tillage radish and 'Defender' radish
Defender Radish	10	100 % 'Defender' radish
Sorghum-Defender Blend	18	2:1 blend (w/w) sorghum/sudan & radish
Sorghum/sudan	25	100 % sorghum/sudan
Farm Blend	35	radish, dwarf essex, turnip, pea, lentil, oat, millet
Rye	90	100 % winter rye

Table 2. Seed wt., moisture, test wt., and grain yield for soybeans following different cover crop blends which had been grown in the fall of the previous year.

Cover Crop Treatment	Moisture	Test Wt.	100-Seed Wt.	Yield
	(%)	(lb/bu)	(g)	(bu/ac)
Mustard Blend	13.4	53.3	21.2	41.0
Radish Blend	14.4	53.3	20.8	40.7
Sorghum-sudan Blend	13.3	53.4	19.8	37.5
Rye	13.6	53.3	19.8	37.1
Defender Radish	13.7	53.3	20.1	35.2
Control	13.3	53.4	20.8	34.9
Farm Blend	13.7	53.4	20.9	34.4
Sorghum-radish Blend	13.5	53.4	20.4	31.4
Mean	*13.6*	*53.4*	*20.5*	*36.5*
CV (%)	*3.0*	*1.0*	*4.1*	*16.0*
P-value	*NS*	*NS*	*NS*	*NS*

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Grazing Cover Crops and Cereal Grains

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INTRODUCTION

Cover crops are becoming an accepted practice to help build soil health. Incorporating livestock into the system contributes to soil biology and reduces the time for nutrient recycling. In addition to these benefits, cover crop grazing also provides feed inputs to the livestock enterprise. In an effort to provide information on the economics and sustainability of such a system, grazing studies are being conducted at the Southeast Research Farm. The animal performance data collected is not replicated, and is only observational for the 2016 growing season.

METHODS

Yearling replacement heifers were utilized for grazing in the 2016 growing season. Grazing began June 3, 2016 and continued through November 21, 2016. The head count ranged from 20 to 28 head during this period and the average starting weight was 830 pounds. Temporary fencing was often used to limit the amount of standing forage the heifers had access to. Depending on the crop, the fence line was moved every 1-3 days. Cattle were moved through a series of annual cereal grains and cover crops as forage was available. The heifers spent 74 of 171 days grazing an alfalfa/grass mix while waiting for cover crops to grow or waiting for the appropriate grazing interval according to herbicide labels. Table 1 shows the different fields grazed and the time spent on each. Weights were collected at the beginning and end of the grazing season, as well as three (3) interim weights prior to switching forage types. Water was hauled to a stock tank as needed and mineral supplement was provided.

RESULTS AND DISCUSSION

The heifers began grazing cereal rye. The rye was in boot stage when grazing began, therefore forage quality was mediocre. Average daily gain (ADG) reflected this as it was only 0.61 lb. /day for the first 70 days of grazing with 28 of those days on rye and 42 on an alfalfa/grass mixture. Nevertheless, 3.5 acres of rye supported 20 head for 28 days, equating to 160 head days per acre. Had grazing begun at an earlier growth stage, both days and ADG may well have increased.

Planting was delayed in a portion of field 203E because of wet conditions. Corn was planted in the wet area June 21, 2016 and then inter-seeded with sorghum-sudan and cowpeas when the decision was made to graze rather than try to produce a grain crop. Grazing began August 12, 2016 with corn in the blister to milk stage. The crop was fenced into blocks and the heifers were given access to about 3 days' worth of grazing at a time. The average dry matter in the field was 9224 pounds per acre prior to turnout and 4366 pounds per acre after grazing which equates to 53% utilization. Most of the aftermath was corn and sorghum-sudan stems. Each acre supported 222 head days. The average daily gain in the field was 3.47 lbs., however, it was only a 19

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day period and fill most likely was a contributing factor in the rate of gain.

Following the corn block, the heifers were moved to a cover crop blend planted after wheat and rye. The blend included radish, turnips, peas, lentils, oats, sorghum and millet. Average daily gain over 33 days of solely cover crop grazing was 2.48 lbs. Field 203W, which had standing water and suppressed growth somewhat, supported 44 head days per acre. Field 202 was better drained and supported the equivalent of 128 head days per acre.

Field 201 was originally planted on July 20, 2016 but was replanted August 24, 2016 due to a poor stand. The cattle grazed this field until November 4, 2016 when they were pulled off due to prussic acid concerns following a hard freeze. There was still forage available, but the opportunity to return the cattle to that field did not arise.

Field 204 was comprised of small plots of cover crops. Grazing lasted only 6 days, but supported 48 head days per acre. Subsequent years will have measurement of crop performance and soil health in grazed and ungrazed plots in this particular field.

CONCLUSION

As stated earlier, this is a one-time snapshot of yearling replacement heifers progressing through a variety of grazing options. Over the course of 171 days in 2016, 20 to 28 head of heifers grazed and gained an average of 1.67 pounds per day. Rye, corn, and sorghum-sudan were grazed, as well as cover crop blends and an alfalfa/grass mix. A total of 4102 head days of grazing occurred on 47.4 acres resulting in over 86 head days per acre. Twenty-five of those 47.4 acres produced a small grain crop in addition to supporting grazing on the following cover crop.

Stage of crop growth in cereal grains definitely affects performance, and ideally, grazing would have started sooner in the rye. As you see in Table 1, however, the rye in field 202 was followed up with a cover crop blend. The two grazing passes combined supported 288 head days per acre. Late planted crops, such as the late-June planted corn in 203E, can be grazed and provide considerable return per acre based on gain or carrying capacity.

Economic value to the livestock enterprise should be calculated according to the class of livestock being produced. For stockers, ADG would be the goal, and you would ultimately want to look at gain per acre as shown in Table 2. For breeding cattle, the emphasis may be more on carrying capacity, or head days per acre, although gain per acre may still be relevant if pairs are being grazed and you are raising pounds of calf. Either way, incorporating livestock grazing into a cover crop system can add immediate economic returns to go along with the long term benefits of improving soil health.

ACKNOWLEDGEMENT

The authors appreciate the contributions of the South Dakota Agricultural Experiment Station to support this project.

Table 1. Summary of forages grazed, starting and ending dates and head days per acre for replacement heifers grazed during the 2016 season at the Southeast Research Farm in 2016.

Field ID	Planting date	Crop	Acres	Grazing Start	Grazing End	Head	Days	Head Days	Head Days/Acre
202	1-Oct	rye	3.5	3-Jun	1-Jul	20	28	560	160
203S	pasture	Alfalfa/grass	13	various	various	23	74	1702	131
203E	21-Jun	Corn/sorghum	2.4	12-Aug	31-Aug	28	19	532	222
203W	18-Jul	Cover crop	7	6-Sep	17-Sep	28	11	308	44
202	21-Jul	Cover crop	3.5	17-Sep	3-Oct	28	16	448	128
201	24-Aug	Cover crop	15	18-Oct	4-Nov	24	17	408	27
204	2-Aug	Cover crop	3	8-Nov	14-Nov	24	6	144	48
		TOTALS	47.4					4102	87

Table 2. Summary of weight gain per acre for different annual forages grazed at the Southeast Research Farm in Beresford, SD during the 2016 season.

DATE	WEIGHT	DAYS	GAIN	ADG	CROP GRAZED	GAIN/ACRE
3-Jun	830					
12-Aug	873	70	43	0.61	Rye & pasture	63
31-Aug	939	19	66	3.47	Corn & sorghum-sudan	770
3-Oct	1021	33	82	2.48	Cover crop blend	219
21-Nov	1115	49	94	1.92	Cover crop blend & pasture	80
	TOTALS	171	285	1.67		

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Drainage Management Research: 2016 Corn Yields in Tile Plots at the Southeast Research Farm

Peter Sexton*, Laurent Ahiablame,
Brad Rops, and Scott Cortus

INTRODUCTION

This paper reports on corn yield from tile drainage studies at the Southeast Farm. A series of twelve tile drainage plots were established at the Southeast Farm in 2013 with the objective of monitoring nitrogen (N) and water movement in tile relative to environmental conditions, and to look at corresponding impacts of drainage on grain yield. These plots were established on marginally drained land which has a history of grain crop production and is capable of producing a crop most years, but was often negatively impacted by excess moisture. Two levels of treatments were imposed on these plots: drained vs. undrained; and use of untreated urea vs. use of urea treated with N stabilizers (NPBT and dicyandiamide).

Another pair of plots were added to the tile drainage study in 2014 on a separate field that had been seeded to reed canarygrass (*Phalaris arundinacea*) and used for producing grass hay because it frequently flooded and was unsuitable for grain crop production due to its poor drainage. These plots were tiled and seeded to soybeans in 2014, oats in 2015, and corn in 2016. This second study had treatments of tile lines being open all year versus tile drainage lines only being open during the growing season (continuous vs. seasonal drainage, respectively).

A second report (Drainage Management Research: Measurement of Water Flow and Quality at the Southeast Farm (SERF AR1614) also contains yield information from this study.

METHODS

The study looking at impact of tile drainage and use of an N stabilizer on corn yield and N movement has been managed without tillage since 2014 (3rd season of no-till management). Nitrogen at a rate of 100 lb per acre as urea treated with Agrotain (field had N credit of 120 lb/ac) on half the plots, and as urea treated with N stabilizers (NPBT and dicyandiamide) – marketed as “SuperU” - was applied on April 19, 2016. The study was laid out as a split plot design with tile drainage as the main plot (drained vs. undrained), and N source as the sub-plot (each sub-plot having its own sampling point for measuring water quality). The plots were seeded to Channel 207 corn on May 6, 2016. Yield samples were taken at harvest from eight rows running a distance of 180 feet. Data from these plots were subjected to standard ANOVA for a RCB split-plot design using Proc GLM in SAS statistical software.

In a separate field split into two large plots, an unreplicated observation study was carried out

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looking at impacts of limiting drainage to the duration of the growing season (seasonal drainage) versus leaving the tile line open all year (continuous drainage). This field was tilled ahead of planting to level out the plots, as the soil had settled over the tile lines during the course of the previous season. Nitrogen was applied as urea across this whole field at a rate of 160 lb. N per acre on April 19, 2016. This field was planted to Channel 207 corn on May 6, 2016. Yield samples were taken from 12 rows running a length of 378 feet in each of the two plots.

RESULTS

In the marginally drained field, the plots with tile drainage showed significantly better stand, and also 19 bu/ac greater grain yield relative to the undrained plots (173.1 vs. 154.5 bu/ac, respectively) (Table 1). There was a significant interaction on grain yield between drainage and N source. The effect of N stabilizers was not statistically significant in either drained or undrained plots (whether analyzed separately or together); however, use of 'SuperU' showed a trend to increase yield by about 14 bu/ac in the undrained plots. Whereas in the drained plots this trend was not apparent. This suggests these N stabilizers are of more value in poorly drained environments than in well drained areas, and is consistent with the known properties of 'SuperU' in lessening susceptibility of N fertilizer to denitrification.

In the field that was poorly drained where we were observing effects of continuous versus seasonal drainage, corn yielded 193 bu/ac with continuous drainage, and 177 bu/ac with seasonal drainage. The spring of 2016 was extremely wet; in this environment it appears seasonal drainage may not have removed enough water to optimize yield of the corn crop. It may have been of benefit in lessening N movement out of the field; that, however, will have to be the subject of a future report. While we do not have an "undrained" control area in this particular field, it is worthwhile to note that without tile drainage this poorly drained area would not have produced an appreciable crop. In the opinion of the authors, the difference with tile drainage in this area is basically the difference between a 190 bu/ac yield, and no grain crop. Staff who have worked at the farm for over 30 years said they were amazed at how tile drainage improved the productivity of this field, making it possible to raise a crop even with a spring marked by unusually wet weather.

Table 1. Grain moisture, test weight, yield, 100-seed wt, and stand for corn raised with and without tile drainage in a marginally drained field at the SDSU Southeast Research Farm in 2016. This trial was conducted in a split-plot design with three replications. Tile drainage was the main plot, and N source was the sub-plot.

Means by Individual Treatment						
Drainage	**N Source**	**Moisture**	**Test Wt.**	**Yield**	**100-Seed Wt.**	**Stand**
		(%)	(lb/bu)	(bu/ac)	(g)	(plants/ac)
No Drainage	Super U	17.2	57.3	161.7	35.0	29363
No Drainage	Urea	16.9	57.0	147.3	32.9	30008
Tile	Super U	16.6	58.1	170.4	34.8	30653
Tile	Urea	16.7	57.1	175.7	35.1	32267
	Mean	*16.9*	*57.4*	*163.8*	*34.4*	*30573*
	CV (%)	*5.2*	*0.6*	*3.6*	*4.3*	*2.6*
Main Effects						
Tile		16.7	57.6	173.1	34.9	31460
No Drainage		17.1	57.2	154.5	33.9	29685
Super U		16.9	57.7	166.1	34.9	30008
Urea		16.8	57.1	161.5	34.0	31137
ANOVA - all variables treated as fixed effects						
Tile		NS	*	*	NS	*
N Source		NS	*	NS [a/]	NS	NS
Tile*N Source		NS	NS	*	NS	NS

a/ note: the effect of N source on yield was non-significant ($P < 0.05$) when data were analyzed within drainage treatments.

<u>Continuous vs. Seasonal Drainage (field 122 - not replicated)</u>

Continuous Drainage: 193 bu/ac
Seasonal Drainage: 177 bu/ac

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Drainage Management Research: Measurement of Water Flow and Quality at the Southeast Farm

Laurent Ahiablame*, Peter Sexton, Christopher Hay, Todd Trooien, and Erin Cortus

INTRODUCTION

Subsurface drainage has increased dramatically in eastern South Dakota in the last several years driven by increases in precipitation and commodity and land prices. This research will evaluate the economic, water quality, and hydrologic impacts of drainage in South Dakota.

We have separated the research into four components-a core component and three associated components. The core component is a monitoring network to study strategies to best manage water and nutrients on tiled and non-tiled fields at plot and field scales. This basic instrumentation setup will feed into the other three research components addressing drainage design criteria and economics, water quality and nutrient management, and hydrologic impacts of drainage (Fig. 1). This report provides a brief discussion of drainage research conducted at the SDSU Southeast Research Farm.

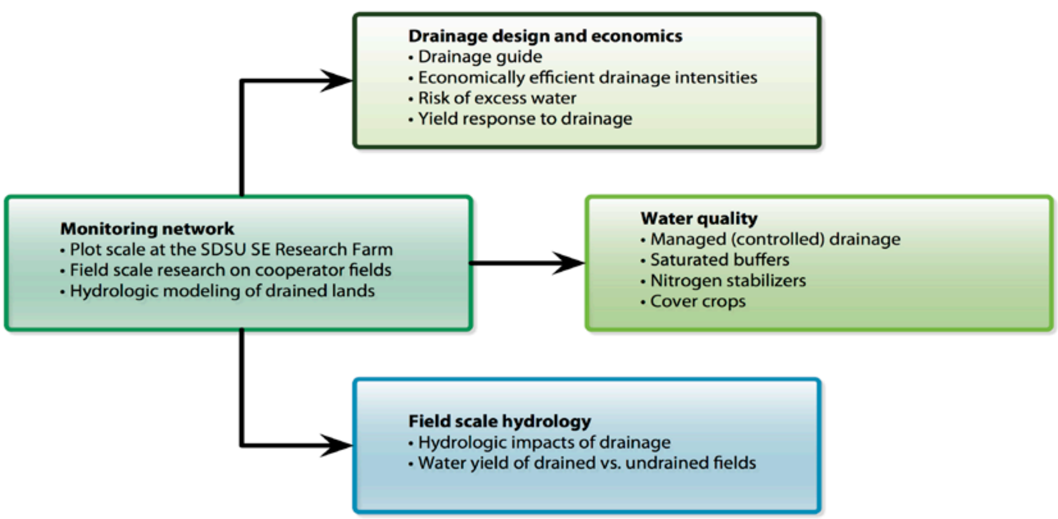

Fig. 1. Diagram of research project components

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OBJECTIVES

The proposed research seeks to:

1. Develop guidance on drainage intensity and drain spacing for representative soils and climatic conditions in South Dakota to maximize economic benefits and minimize negative environmental impacts
2. Evaluate the impact of nitrogen stabilizers on nitrate losses from drained areas
3. Compare the water yield among conventionally drained, managed drained, and undrained fields
4. Demonstrate and evaluate the use of managed (controlled) drainage and saturated buffers for reducing nitrate losses from tile drained fields
5. Evaluate potential cover crop strategies to manage wet areas and to tie up nutrients and reduce drainage outflow.

METHODS

Study Plots

Two sets of subdrainage plots were installed at the SDSU Southeast Research Farm. The first set of plots (North plots) were installed during the week of May 6–10, 2013. The drain lines were installed in six plots of approximately 1-acre size across two fields that have been in a long-term corn-soybean rotation (Fig. 2). The drain lines were installed at a 4-ft. depth with 80-ft. spacings. For the soils in the plots, this results in an estimated drainage coefficient (design capacity of the drainage system) of ½ inch per day at 4-ft deep or ⅜ inches per day when operated at a 3-ft. outlet depth. Three of the plots are operated as drained to a 3-ft. depth, and the other three plots have the outlets closed and are operated as undrained.

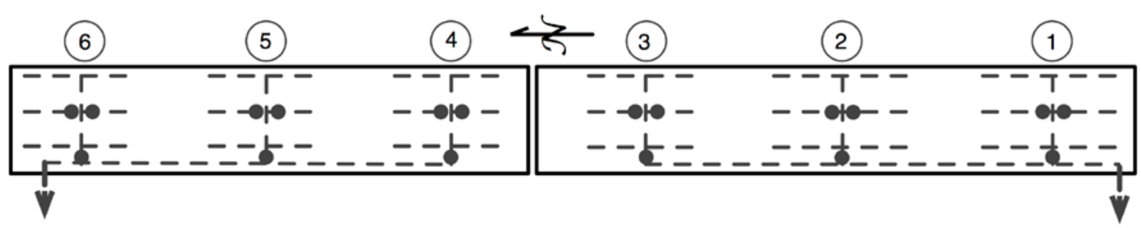

Fig. 2. North subsurface drainage plots at the Southeast Research Farm. Dashed lines are the tile lines, and dots are the control structures. Plots 2, 3, and 6 are drained to a 3-ft. depth, and plots 1, 4, and 5 have the outlets closed and are managed as undrained. Within each of these plots, half of the plot receives conventional urea nitrogen applications and the other half will receive applications of nitrogen with a nitrogen stabilizer (nitropyrin) during corn years.

The study is set up in a split-plot design with drainage as the whole-plot treatment and nitrogen as the split-plot treatment. The tiled plot area was seeded to soybeans in the spring of 2013 after disking operations to smooth out the fields following the drainage installation. The drained plots were planted on June 3rd, 2013. Because of wet conditions, planting was delayed on the undrained plots until June 18th and 20th. With the beginning of a new study, however, there was some initial confusion over study goals that resulted in one of the drained plots being planted later than it could have been. Corn was planted in 2014 followed by soybeans in 2015 and corn in 2016 on these plots.

Soil moisture, water level, and precipitation monitoring instrumentation were installed in the summer of 2013. Stevens Hydra Probe II sensors for continuous measurement of soil water content, soil temperature, and electrical conductivity were installed on the control (conventional nitrogen) side of each whole-plot at depths of 6″, 18″, 30″, and 42″. Decagon CTD sensors were installed in each of the control structures for continuous measurement of water level (for calculating drain discharge), water temperature, and electrical conductivity. Monitoring wells were installed in each whole-plot, midway between two tile lines, for monitoring shallow groundwater levels. Additionally, two tipping bucket gauges were installed for measuring precipitation. Other climatological measurements will come from the existing weather station at the research farm. Table 1 summarizes the datasets being collected from the six research plots to date.

The second set of subdrainage plots (9.3-acre) were installed during the week of September 23, 2013 and named the South plots. The plots consist of a 4-acre plot for conventional drainage and a 5.3-acre plot for drainage water management (DWM) (Fig. 3). The tiles were installed at 4-ft deep with 40-ft spacing. Oats were planted on these plots in 2015 and corn was planted in 2016 to match the North plots (Fig. 2). The data collected on North plots are also being collected for these plots, except crop yield data will be collected from 2016 harvest. The conventional drainage plot operated with an estimated drainage coefficient (design capacity of the drainage system) of ⅜ inches per day. The outlet of the DWM plot is controlled with a riser board which is removed, raised or lowered, as needed, according to growing and non-growing seasons. Specifically;

1. The boards are removed in early April for corn and mid-April for soybeans. The boards should be removed approximately 3 weeks prior to planting, depending on existing and forecast conditions.
2. After planting:
   - Corn: Boards are replaced to 18 inches below the soil surface at the control structure. When corn reaches the 4-leaf stage, the outlet elevation should be lowered to 24 inches below the soil surface. When corn reaches the 10-leaf stage, the outlet elevation are lowered to 30 inches below the surface and left there for the remainder of the growing season.
   - Soybean: Boards are replaced to 24 inches below the soil surface at the control structure until the beans reach 8 inches tall and then

the boards are lowered to 30 inches below the surface and left there for the remainder of the growing season.

3. If needed, boards are removed 10 days before harvest.
4. Boards are replaced within one week after harvest to 6 inches below the soil surface.

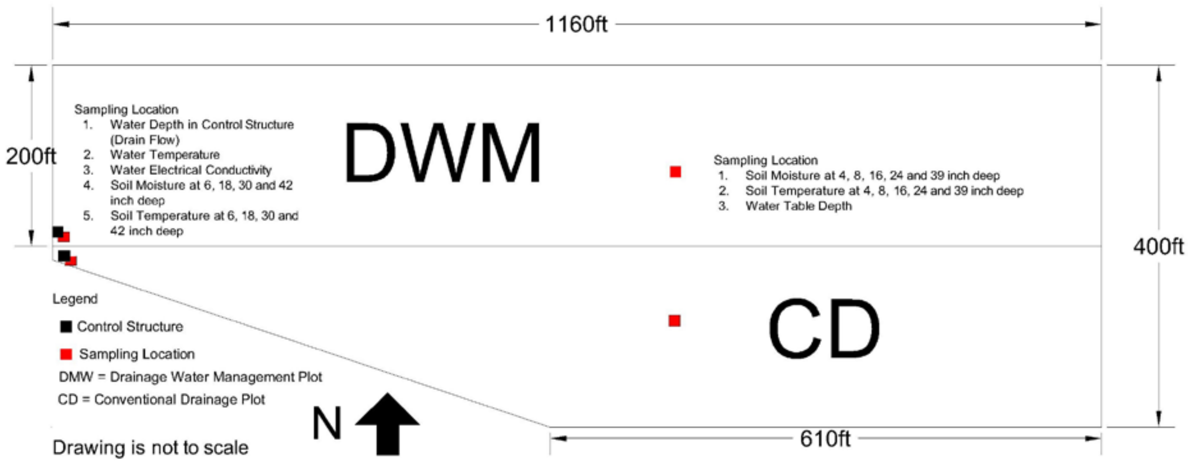

Fig. 3. Layout of Drainage Water Management Plots (i.e. South Plots) at SDSU SERF near Beresford, SD

Statistical Analysis

The data have not yet been statistically analyzed to determine the effects of drainage on soil water characteristics and crop yields. The information presented in this report is strictly a summary of field data collected.

Table 1. List of data being collected from research plots at SDSU Southeast Research Farm near Beresford, South Dakota.

No.	Data Type	Frequency	Equipment	Description	Start Date	End Date	Unit of Measmt	Remark
1	Drain Flow	15 min	Decagon CTD	Water Depth in Control Structure	9/11/2013	Present	mm	Removed during winter
2	Temperature	15 min	Decagon CTD	Water Temperature	9/11/2013	Present	°C	Removed during winter
3	Electrical Conductivity	15 min	Decagon CTD	Water Electrical Conductivity	9/11/2013	Present	dS/m	Removed during winter
4	Soil Moisture	15 min	Stevens Hydra Probe II	Soil Moisture Depth - 6 inch	9/11/2013	Present	m^3/m^3	Continuous
5	Soil Moisture	15 min	Stevens Hydra Probe II	Soil Moisture Depth - 18 inch	9/11/2013	Present	m^3/m^3	Continuous
6	Soil Moisture	15 min	Stevens Hydra Probe II	Soil Moisture Depth - 30 inch	9/11/2013	Present	m^3/m^3	Continuous
7	Soil Moisture	15 min	Stevens Hydra Probe II	Soil Moisture Depth - 42 inch	9/11/2013	Present	m^3/m^3	Continuous
8	Soil Moisture	15 min	Decagon 5TM	Soil Moisture Depth - 54 inch	4/30/2015	Present	Ea	Continuous
9	Soil Temperature	15 min	Stevens Hydra Probe II	Soil Temperature Depth - 6 inch	9/11/2013	Present	°C	Continuous
10	Soil Temperature	15 min	Stevens Hydra Probe II	Soil Temperature Depth - 18 inch	9/11/2013	Present	°C	Continuous
11	Soil Temperature	15 min	Stevens Hydra Probe II	Soil Temperature Depth - 30 inch	9/11/2013	Present	°C	Continuous
12	Soil Temperature	15 min	Stevens Hydra Probe II	Soil Temperature Depth - 42 inch	9/11/2013	Present	°C	Continuous
13	Soil Temperature	15 min	Decagon 5TM	Soil Temperature Depth - 54 inch	4/30/2015	Present	°C	Continuous
14	Soil Electrical Conductivity	15 min	Stevens Hydra Probe II	Soil Electrical Conductivity Depth - 6 inch	9/11/2013	Present	S/m	Continuous
15	Soil Electrical Conductivity	15 min	Stevens Hydra Probe II	Soil Electrical Conductivity Depth - 18 inch	9/11/2013	Present	S/m	Continuous
16	Soil Electrical Conductivity	15 min	Stevens Hydra Probe II	Soil Electrical Conductivity Depth - 30 inch	9/11/2013	Present	S/m	Continuous
17	Soil Electrical Conductivity	15 min	Stevens Hydra Probe II	Soil Electrical Conductivity Depth - 42 inch	9/11/2013	Present	S/m	Continuous
18	Soil Moisture	15 min	UMS T4 Tensiometer	Tensiometer, Depth - 54 inch	4/30/2015	Present	KPa	Wet End
19	Soil Moisture	15 min	UMS T4 Tensiometer	Tensiometer, Depth - 78 inch	4/30/2015	Present	KPa	Wet End
20	Soil Moisture	15 min	Camp Sci 229	Soil Matric Potential, Depth - 54 inch	4/30/2015	Present	Degree Celcius	Dry End

21	Soil Moisture	15 min	Camp Sci 229	Soil Matric Potential, Depth - 78 inch	4/30/2015	Present	Degree Celcius	Dry End
22	Water Table Depth	15 min	Hobo Water Level Logger	Water Depth - Observation Well	8/21/2014	Present	m wrt sensor depth	Removed during winter
23	Water Table Depth	15 min	Hobo Water Level Logger	Water Depth - Deep Well	8/21/2014	Present	m wrt sensor depth	Removed during winter
24	Soil Penetration Resistance	Weekly	Cone Penetrometer	Cone Penetration	4/9/2014	7/11/2014	KPa	Growing Season
					3/31/2015	10/6/2015	KPa	Growing Season
25	Leaf Area Index	Weekly	Ceptometer	Leaf Area Index	7/9/2014	10/2/2014	unitless	Growing Season
					6/23/2015	9/1/2015	unitless	Growing Season
26	Nutrient Analysis	Random	Grab Sampling Method	Nitrate-Nitrate Analysis	6/10/2014	7/22/2014	mg/L	When there is flow
					5/13/2015	7/7/2015	mg/L	When there is flow
27	Precipitation	15 min	Tipping Buck Rain Gauge	Precipitation	9/11/2013	Present	mm	Continuous
28	Infiltration	Monthly	4 inch Infiltration Ring	Sorptivity	5/8/2014	8/21/2014	ml/min	Growing Season
					3/31/2015	7/14/2015	ml/min	
29	Bulk Density	Year 1, 3, 5 and 10	AMS bulk density kit	Bulk Density			gm/cm^3	Within 1 month of planting
30	Grain Yield	Yearly	Kincaid Plot Combine	Plot area 15' x approximately 185'	5/1/2013	Present	bu/acre	Annually
31	100 Seed Weight	Yearly	Hand Count / Gram Scale	Hand Count	5/1/2013	Present	grams	Annually
32	Stand Count	Yearly	Hand Count	Hand Count	5/1/2013	Present	plants	Annually
33	Soil Sampling & Analysis (Nitrate-N, Olsen P, K, pH, Zn, S and EC (1:1 saturated paste))	Yearly	Tractor Probe	Analysis by SDSU Soils Lab	5/1/2013	Present	ppm	Annually
34	Corn Biomass Nutrient Analysis	Year 2	ICP tissue analysis	6' Samples; Dried, Weighed; Subsample Analyzed	11/7/2014	11/7/2014	lbs./ac	After Harvest

RESULTS

The results presented in this report are for the year 2016, which is then compared to the long-term average (i.e. 2014-2016 data) of each parameter examined.

- Tile flow appears to increase with incident precipitation amount but lower than the long-term average tile flow. Conventionally drained plots generally have larger drain flow compared to controlled drainage plots.

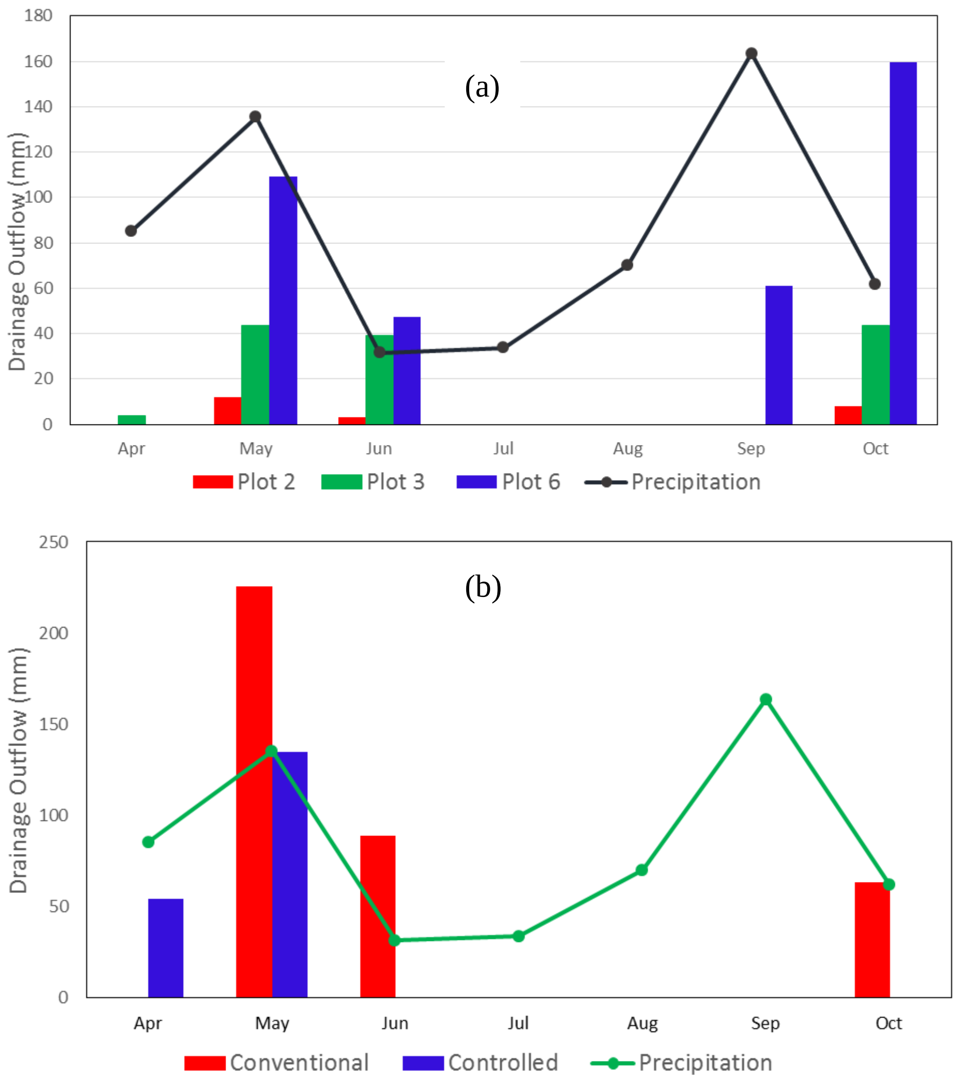

Fig. 4. Tile flow from (a) drained and undrained plots, and (b) controlled and conventional drainage plots.

- Nitrate loss in tile water is generally lower in undrained plots than drained plots, and lower in controlled drainage plots compared to conventional drainage plots. The year 2016 appears to have less nitrate loss in tile water compared to the long-term average.

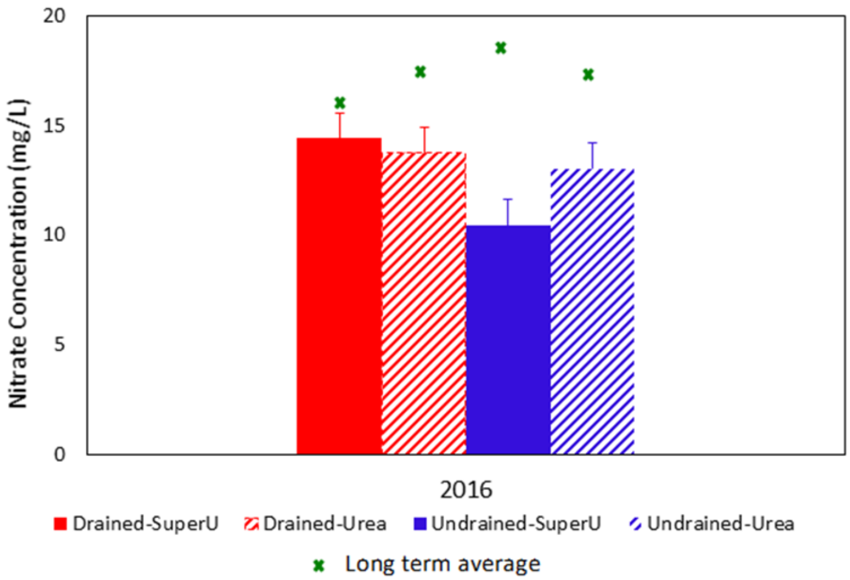

Fig. 5a. Tile nitrate concentration from drained and undrained plots

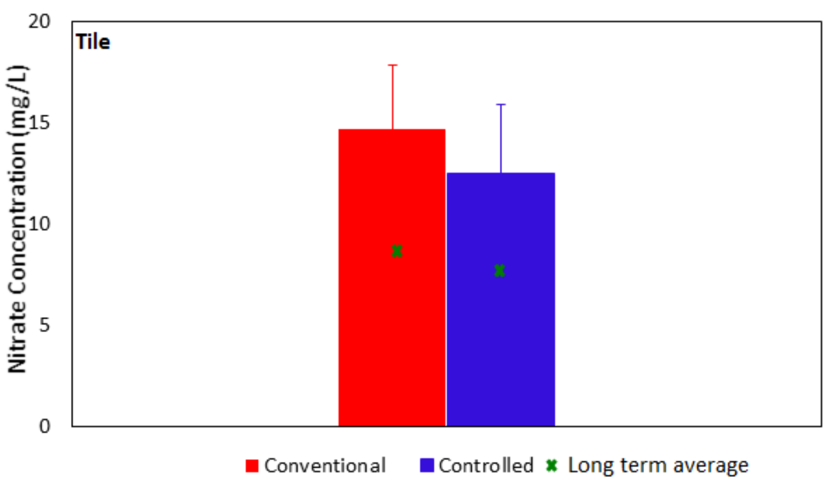

Fig. 5b. Tile nitrate concentration from controlled and conventional drainage plots

- Nitrate concentration level in shallow groundwater water is higher in undrained plots than drained plots, and lower in controlled drainage plots compared to conventional drainage plots. Similar to nitrate concentration in tile water, the year 2016 seems to have relatively less nitrate loss to groundwater compared to the long-term average.

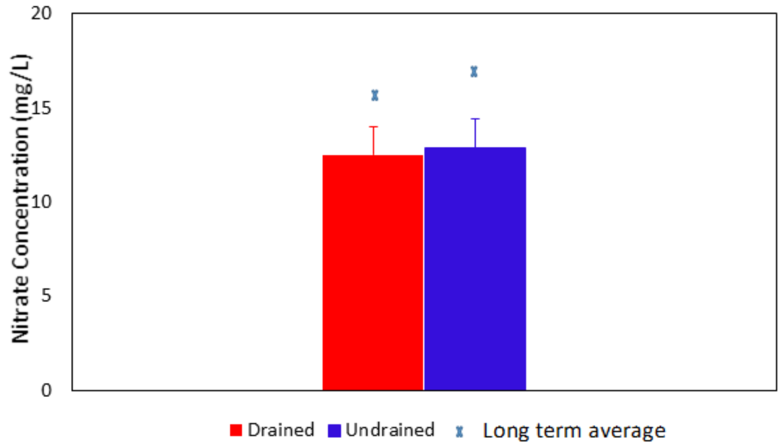

Fig. 6a. Nitrate concentration in shallow groundwater from drained and undrained plots

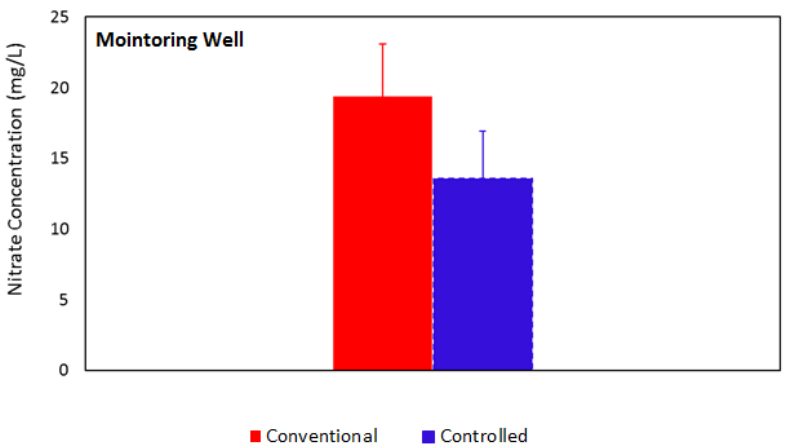

Fig. 6b. Nitrate concentration in shallow groundwater from controlled and conventional drainage plots

- The benefits of agricultural tile drainage are reflected in the yield data during the year 2016 and all three years of the study. There is no trend in yield between Super U and Urea plots across the drained and undrained plots. Corn yield in conventional drainage plot is slightly higher than that of the controlled drainage plot.

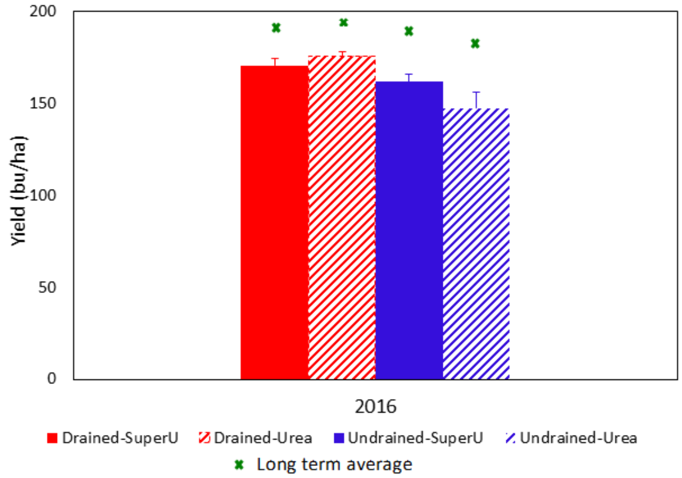

Fig. 7a. Corn yield from drained and undrained plots

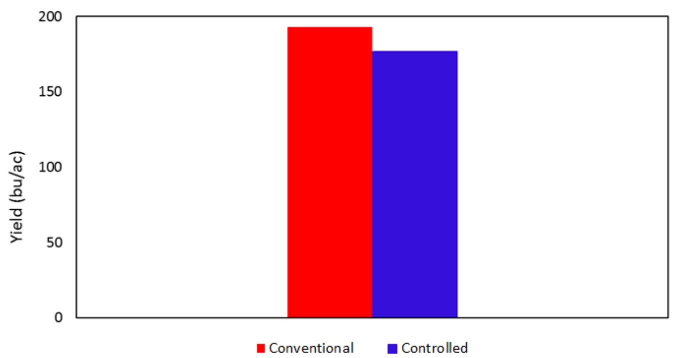

Fig. 7b. Corn yield from controlled and conventional drainage plots

<u>ACKNOWLEDGEMENTS</u>

This research was supported by the South Dakota Corn Utilization Council, the Minnesota Corn Research and Promotion Council, the South Dakota Board of Regents and the National Institute of Food and Agriculture through the South Dakota State University Agricultural Experiment Station. The work was conducted wholly or in-part at the Southeast Research Farm Field Station of SDSU AES. We wish to acknowledge the assistance of additional in-kind support provided by Advanced Drainage Systems, Inc. and Agri Drain Corporation.

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Corn and Soybean Yield Responses to Tillage and Residue Management in 2016

Howard J. Woodard*
and Brad Rops

INTRODUCTION

A long-term corn and soybean rotation was established in 2010 to determine the influence of tillage and residue management treatments on grain yields. The location of the corn and soybean plots alternated each year within the same site area in the northeastern quarter of the Southeast Research Farm. The main soil on the research site was determined to be an Egan/Trent soil with a silty clay loam textural class (22% sand, 31% silt, 47% clay) and with 3.9% organic matter.

The study was implemented with two levels of tillage (no-till and conventional-till), and two levels of corn residue management (corn residue-removed and residue-retained). After grain was harvested from the research site in the Fall of 2015, plots for next growing season were prepared by removing corn residue from selected treatment plots with a commercial rake and baler owned by the research farm. About 80-90% of the corn residue was removed from the "residue removed" treatment plots in this process and the surface of the plot area was generally clean. (No soybean residue was removed from soybean plots).

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A chisel-plow operation was applied to the conventional-tilled treatment plots afterwards. In the spring of 2016, a field cultivator operation prepared the seed bed in the conventional-tilled plots for both the corn and soybeans. Corn seed was planted in late April with 30" row spacing at a rate of 32,000 seeds/a. Soybean seed was planted in mid-May in 30" rows at a rate of 150,000 seeds/a. No fertilizer was applied any plots since the soil test P and K levels were medium-high and we needed to document the nutrient balances of the various treatment plots. Grain from both crops was harvested in October at physiological maturity and final grain yields were estimated on an acre basis at 15% moisture for corn and 13.5% for soybeans.

RESULTS

The overall mean corn grain yield range in 2016 (105.4 - 136.5 bu/a) was much below the five-year corn grain yield average for the region (Table 1). The summer was characterized by warm weather throughout the growing season, but was not excessively hot. Rainfall amounts were greater than the average for April and May, and may have contributed to a slightly lower stand. However, June and July precipitation was lower than normal and certainly contributed to lower than average yields. Fertilizer N was not applied to these corn plots and together with the dryer mid-season, probably contributed to lower yields. Because of the lower yield potential, the statistical significance observed in the conventional vs. no-till plots when residue was removed was probably not relevant.

Table 1. Corn grain yield response to tillage and residue management treatments at Southeast Research Farm, Beresford, SD, in 2016.

	Corn Residue Management		
Tillage	Removed (2014)	Retained	$LSD_{(.05)}$
	bu/ac	bu/ac	bu/ac
No-Till	105.4	111.5	N.S.
Conventional	136.5	121.1	N.S.
$LSD_{(.05)}$	*	N.S.	

N.S. indicated statistical non-significance at the alpha = .05 level.
* Indicates significance at the alpha = .1 level

The overall mean soybean grain yield range (49.5 - 56.8 bu/a) was somewhat lower than the five-year grain soybean yield average for the region (Table 2). Neither the tillage treatment nor the residue management treatment (corn residue removed from the previous year) had any influence on final grain yield.

Table 2. Soybean grain yield response to tillage and residue management treatments at Southeast Research Farm, Beresford, SD, in 2016.

	Corn Residue Management		
Tillage	Removed (2015)	Retained	$LSD_{(.05)}$
	bu/ac	bu/ac	bu/ac
No-Till	54.0	53.9	N.S.
Conventional	49.5	56.8	N.S.
$LSD_{(.05)}$	N.S.	N.S.	

N.S. indicated statistical non-significance at the alpha = .05 level.

SUMMARY

There was a no clear advantage of conventional-till vs. no-till, or the either residue management treatment on soybean yields during this cropping season. Since the yield potential for corn grain production was lowered due to probable weather conditions and a production practice oversight, there was no apparent relevance for comparing any of the tillage-residue management combinations on corn grain yield.

ACKNOWLEDGEMENTS

The authors appreciate the contributions of the South Dakota Agricultural Experiment Station in Brookings, SD to support this project.

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Corn Nitrogen Rate Study, Crooks SD, 2016

Anthony Bly*, Al Miron,
Sara Berg, and David Karki

INTRODUCTION

South Dakota (SD) corn nitrogen (N) rate recommendation was last established in 1991 and is based on the coefficient of 1.2 lbs N/bu of the yield goal. The South Dakota corn N rate calculator subtracts the pre-plant soil test NO_3-N (0-2ft) and legume credits and adds 30 lbs N/a for recently established no-till. Much improved corn genetics, shifting farming practices and climate changes warrant for re-calibration of corn N rate. Frequent research is required to update corn recommendations. Therefore, a corn N rate study was conducted near Crooks, SD in 2016.

Materials and Methods

Item	Description
Planting date	May 3, 2016
Plot size	15 ft x 30 ft
Corn hybrid	DKC 53-56
Seeding rate	32,000 s/ac
Row Spacing	30 inches
Tillage system	No-till
N rates (application date)	0, 40, 80, 120, 160, 200 (5-4-16) as SuperU
N application method	Surface broadcast immediately after planting
Top-dress N application treatment (date)	80 lbs N/a (5-4-16) and 80 lbs N/a (6-5-16)
Urea (volatilization comparison) (date)	80 lbs N/a as urea on 5-4-16
SPAD meter reading	8-24-16 (ear leaf)
Pre-plant soil nitrate (0-2ft)	52 lbs/a
Harvest date and area	Oct 10, 2016 (20 ft of row from each plot)
N coefficient determination	Linear Plateau method
Statistics (RCBD)	N rates, Top dress and urea comparisons.

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SUMMARY

N rate significantly influenced grain yield (Table 1). However, the N application timing comparison and urea volatilization comparisons were not significantly different (Table 1). SPAD meter reading and N rate correlated very well (Figure 1). The linear/plateau method estimated the N coefficient for this site at 1.07 lbs N/bu (Figure 2).

ACKNOWLEDGMENTS

Thank you to Al Miron for providing the field resources for this research and partial funding support from SDSU Extension.

Table 1. Influence of N rate, N source and application timing on corn grain yield near Crooks, SD in 2016.

N rate and treatment	Fertilizer Material	Grain Yield
N Rate comparison (lbs N/a)[A]		bu/a
0	none	132.8 c
40	SuperU[B]	165.7 b
80	SuperU	188.3 a
120	SuperU	194.4 a
160	SuperU	198.6 a
200	SuperU	202.9 a
Pr>F		0.01
CV%		7.0
$LSD_{(.05)}$		19.1
N timing comparison (lbs N/a)		
160	SuperU	198.6
80 preplant + 80 topdress	SuperU	193.7
Pr>F		0.61
CV%		6.2
$LSD_{(.05)}$		NS
Urea volatilization comparison (lbs N/a)		
80	SuperU	185.9
80	Urea	188.3
Pr>F		0.69
CV%		4.1
$LSD_{(.05)}$		NS

[A] surface broadcast application immediately after planting.
[B] urea + NBPT (urease inhibitor) + DCD (nitrification inhibitor)

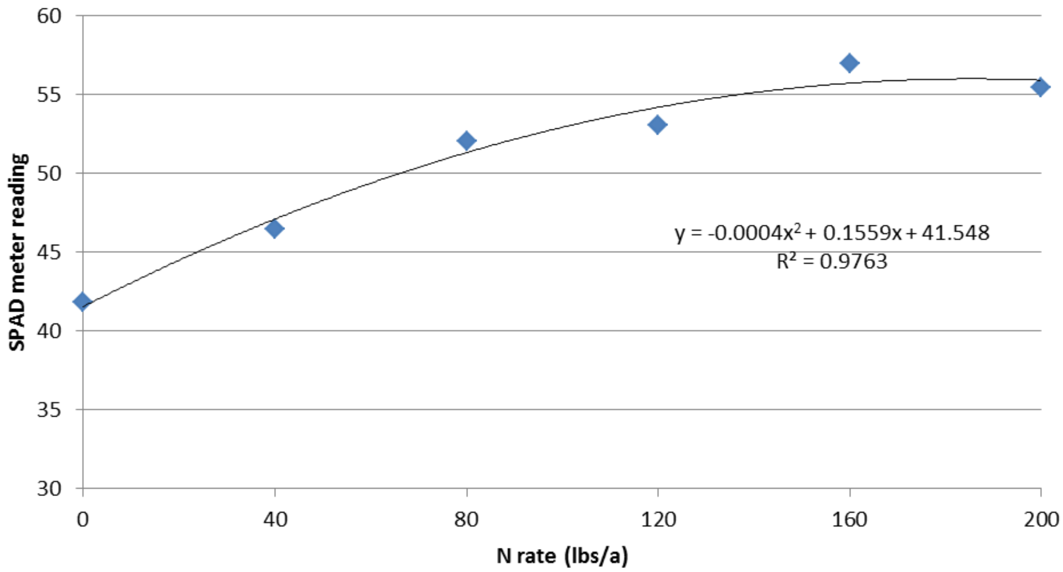
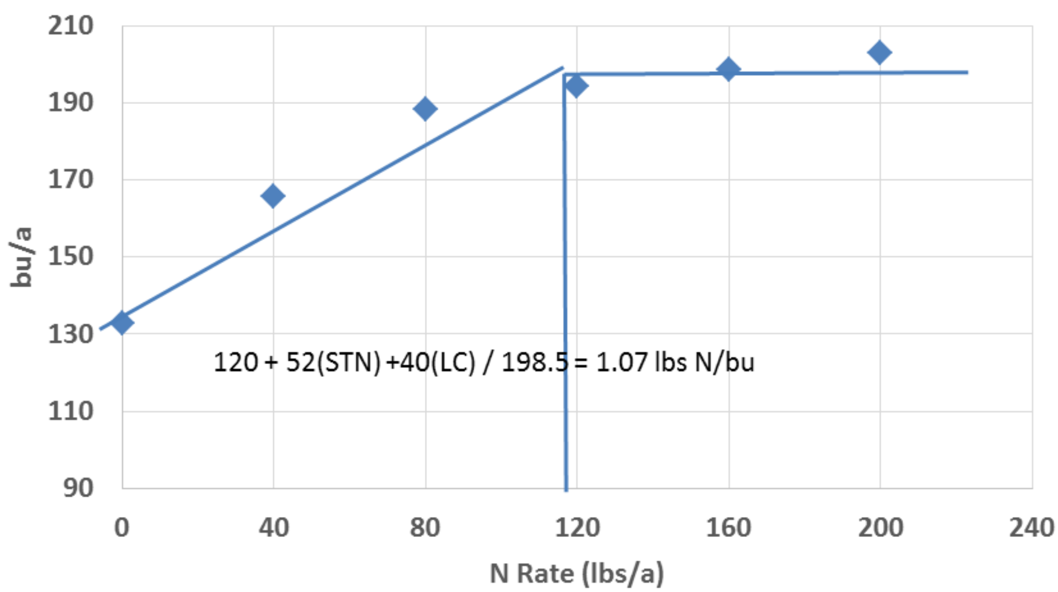


Figure 1. Influence of surface applied, broadcast SuperU, N rate on corn ear leaf SPAD, near Crooks SD, 2016.

Figure 2. Corn N rate and corn grain yield, Crooks, SD, 2016



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Influence of Generate on Corn Yield

Anthony Bly* and Brad Rops

INTRODUCTION

Soil microbiology is very important in nutrient cycling. There are many soil microbiology enhancement amendments available that have various claims as to how they improve the activity of soil micro-organisms that ultimately enhances plant nutrient availability. Generate is an example of such a soil amendment. However, research needs to be conducted to test the efficacy of these products to determine the probability and size of corn response.

Table 1. Materials and Methods for Generate research project for corn.

Item	Description
Tillage	No-till
Hybrid (planting date)	DKC 46-36 (May 18)
Rotations	Soybean – Oats – Corn
Row Spacing (inches)	30 inches
Generate rate	1 pt/ac
Application timing	Applied with starter fertilizer.
Starter fertilizer (with seed)	1.7 gpa 10-34-0, 1.7 gpa (28%), 1.7 gpa water
Control plot	Starter fertilizer only
Harvest method	Combine and weigh wagon
Plot size	Approximately 30 x 300 ft
Replications	5
Statistics	ANOVA Pr>F mean separation

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SUMMARY

Treatment plots with starter fertilizer and Generate (1 pt/ac) had statistically significant higher grain yield (Table 2). A group of six field studies conducted by Iowa State University in Northwest Iowa during 2013 showed no statistical grain yield improvement from Generate when compared with a control treatment with similar starter fertilizers. At one site, the treatment with Generate and starter fertilizer had significantly greater grain yield when compared with a control treatment with neither starter fertilizer nor Generate. Therefore, using the data in this report as a decision aide for the use of this soil amendment with corn should be used with caution. More research needs to be conducted to determine the probability and size of corn grain responses before recommendations can be made for the use this product.

ACKNOWLEDGEMENTS

This research project partially funded by SDSU Extension, the South Dakota Agriculture Experiment Station, and the Southeast Research Farm.

Table 2. Influence of Generate on corn grain yield at Southeast Research farm in 2016.

Treatment	Grain Yield
	-----bu/ac -----
Starter[A]	198.4
Starter[A] + Generate[B]	206.7
Stats	
Pr>F	0.01
LSD(.05)	4.9
CV%	1.4

[A] 5 gpa (1.7 gal. 10-34-0, 1.7 gal 28%, 1.7 gal water)
[B] 16 oz/a

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Influence of Biological Soil Additives on Soybean Yield near Garretson, SD in 2016

Anthony Bly* (SDSU Extension, Soils Field Specialist, Sioux Falls)

Table 1. Materials and Methods

Item	**Description**
Soybean variety	Mustang 19726 RR2Y
Planting date	May 18, 2016
Biological soil additive	Sunrise: 4 lbs/ac, Soil Balance: 5 lbs/ac
Application method	Powder with seed at planting.
Plot size	30 ft x 325 ft
Harvest method	Producer combine and weigh wagon
Statistics (RCBD)	ANOVA with 3 replications

SUMMARY

Soybean grain yields were very good, however no significant grain yield differences were measured (Table 2).

ACKNOWLEDGEMENTS

Funding partially provided by South Dakota Soybean Research and Promotion Council and SDSU Extension.

Table 2. Influence of biological soil additive on soybean yield near Garretson SD in 2016.

	Soil Microbial product	
	Sunrise[A]	Soil Balance[B]
	-------------- bu/ac --------------	
Control	71.3	74.9
Treated	72.3	76.2
Pr>F	0.72	0.28
LSD(.05)	9.9	3.8
CV%	3.9	1.5

[A] 4 lbs/ac applied as powder in seed furrow.
[B] 5 lbs/ac applied as powder in seed furrow.
3 % soil organic matter

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Nitrogen influence on Soybean Grain Yield in Eastern South Dakota in 2016

Anthony Bly*, Sara Berg,
and David Karki, SDSU Extension

SUMMARY

Nitrogen did not statistically influence grain yield at any of the sites (Table 2). However some numerical differences were observed.

ACKNOWLEDGMENTS

Funding partially provided by South Dakota Soybean Research and Promotion Council and SDSU Extension.

Table 1. Materials and Methods for soybean nitrogen studies in eastern South Dakota in 2016.

Item	Description
Locations	South Shore, Henry, Arlington, Crooks and Garretson
Tillage	No-till (Arlington, Crooks, Garretson) Conventional (South Shore, Henry)
Variety (planting date)	Asgrow 14-28 (May 18)
Rotations	Corn/soybean
Row Spacing (inches)	Henry, South Shore, and Garretson = 30, Arlington = 7.5, Crooks = 15
N rates and timing	0, 100 (R3) and 500 (V3) lbs N/a. (growth stages)
Application method	Surface broadcast
Harvest method	Small plot combine
Plot size	10 ft x 20 ft
Replications	4
Statistics	ANOVA Pr>F mean separation

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Table 2. Nitrogen influence on soybean grain yield at several locations in eastern South Dakota during 2016.

Nutrient	Crooks	Garretson	Arlington	Henry	NE Farm	Average
	-- bu/ac --					
Control	65.0	53.6	56.4	43.8	44.5	52.4
500 lbs N/a[A]	68.4	59.7	57.7	40.1	46.5	53.9
100 lbs N/a[B]	66.4	61.7	61.4	38.3	46.7	54.2
CV %	9.1	10.6	9.0	15.6	11.2	21.3
Pr>F	0.73	0.48	0.42	0.48	0.80	0.90
$LSD_{(.05)}$	NS	NS	NS	NS	NS	NS

[A] applied as surface broadcast urea at V3 growth stage.
[B] applied as surface broadcast urea at R3 growth stage.

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Nitrogen Timing and Product Effects on No-till Corn in 2016

Anthony Bly*, Sara Berg, and David Karki

Corn nitrogen use efficiency is greatly influenced by the environment. Since the corn plant takes up a majority of nitrogen later in the growing season, nitrogen loss potential after application is very possible. Side-dress or top-dress nitrogen applications have been shown to improve grain yield over pre-plant. Nitrogen fertilizer additives that slow urease activity to prevent urea volatilization and nitrification inhibitors to keep the nitrogen as ammonium and prevent leaching or denitrification as nitrate are available for nitrogen application management. Slow release polymer coated urea is another option to delay nitrogen availability for the corn until later in the growing season. Therefore, a research project investigating these nitrogen fertilizer additives and polymer coated urea along with application timing and blend combinations was conducted on long term no-till field.

Table 1. Materials and Methods

Item	**Description**
Location	Eastern Minnehaha county
Tillage method	No-till (22 years)
Crop rotation	Oats/Soybeans
Hybrid (seeding rate)	Mustang 0995 conventional (32,500/a)
Nitrogen Fertilizer materials	Urea
	ESN (polymer coated, slow release) urea
	SuperU (Agrotain and DCD)
Agrotain	NBPT – urease inhibitor – volatilization reduction
DCD	Dicyandiamide – nitrification inhibitor
Nitrogen Application treatments	Table 2
Pre-pant nitrogen application date	May 4, 2016
Nitrogen fertilizer application method	Surface broadcast
Planting date	May 16, 2016
Top-dress (V5-V6) nitrogen application date	June 17, 2016
Plot size	15 ft x 30 ft
Replications	4
SPAD meter readings	Ear leaf relative greenness
Grain harvest	October 16, 2016
Statistical analysis (RCBD)	SAS – ANOVA of SPAD and yield

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SUMMARY

The SPAD meter reading values and grain yield were statistically significant (Table 2). Only the control plot had significantly lower SPAD and grain yield. A nitrogen response curve was developed from the data, pooling all of the 80 lbs N/a treatment yields and plotting the data with the control (0 lbs N/a), the grower rate (150 lbs N/a) and the high rate (200 lbs N/a) (Figure 1). Using a simple linear/plateau method for determining estimated optimum N rate, this showed that it took about 95 lbs N/a to maximize yield (fertilizer + soil test N).

ACKNOWLEDGMENTS

This research partially funded by SDSU Extension.

Table 2. Influence of Nitrogen fertilizer and application timing on no-till corn ear leaf greenness (SPAD) and grain yield near Garretson SD in 2016.

		% Fertilizer Material			% Timing Applied			
Trt	N Rate	urea	ESN[A]	SuperU[B]	Pre-plant[C]	Top-dress[D]	SPAD[E]	Grain Yield[F]
	lbs/a							bu/a
1	0						43.5 b	166.7 b
2	80	100			100		57.4 a	211.3 a
3	80	100			50	50	57.9 a	206.5 a
4	80	50	50		100		56.2 a	216.5 a
5	80			100	100		58.3 a	211.4 a
6	80			100	50	50	58.3 a	211.8 a
7	80		50	50	100		56.8 a	205.5 a
8	200			100	100		60.1 a	219.2 a
9[G]	140	100			50	50	58.7 a	218.5 a
						CV	5.3	8.7
						Pr>F	0.01	0.01
						LSD(.05)	3.4	26.5

[A] ESN – Environmentally Sensitive Nitrogen (polymer coated urea, slow release)
[B] SuperU – Urea treated with NBPT (urease inhibitor) and DCD (nitrification inhibitor)
[C] pre-plant surface broadcast fertilizer application (5-15-15)
[D] top-dress surface broadcast fertilizer application at V5-V6 (6-23-15)
[E] SPAD meter reading (relative leaf greenness)
[F] grain yield adjusted to 15% moisture
[G] cooperator N rate

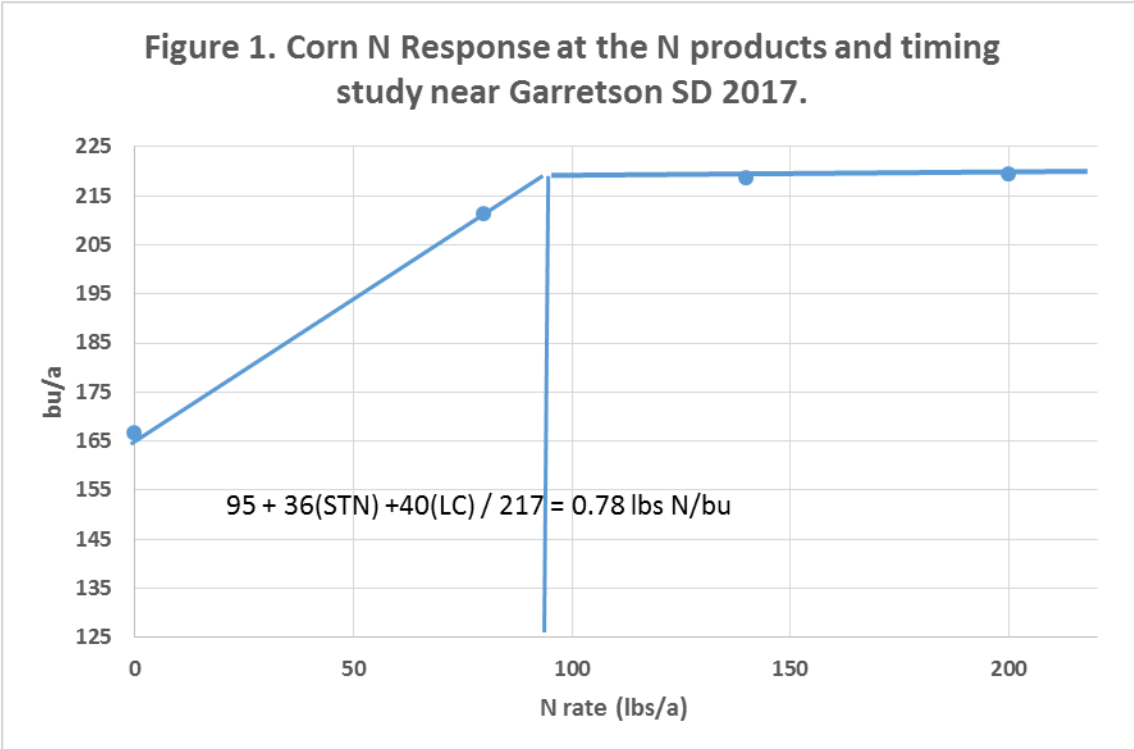
Figure 1. Corn N Response at the N products and timing study near Garretson SD 2017.
225
215
205
195
185
175
165
155
145
135
125
bu/a
0
50
100
150
200
N rate (lbs/a)
95 + 36(STN) +40(LC) / 217 = 0.78 lbs N/bu

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Effects of In-furrow Environmentally Sensitive Nitrogen (ESN) Application on Soybean Population and Yield

Anthony Bly* (SDSU Extension, Soils Field Specialist, Sioux Falls SD)

SUMMARY

ESN as seed application did not significantly reduce soybean population or increase grain yield. Study details are presented in Tables 1 and 2.

Table 1. Materials and Methods for ESN in Minnehaha County, South Dakota in 2016.

Item	Description
Location	Minnehaha County, Valley Springs
Tillage rotations	No-till corn/soybean
Variety (planting date, seeding rate)	Mustang 19726 RR2Y (May 18, 2016)
Row Spacing (inches)	10
ESN In-furrow rate	100 lbs/a
What is ESN?	Environmentally Sensitive Nitrogen (poly coated urea, 44-0-0)
Harvest method	Producer combine and weigh wagon
Plot size	30 ft x 350 ft
Replications	4
Statistics	ANOVA Pr>F mean separation

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Table 2. Influence of in-furrow ESN on soybean plant population and grain yield in 2016, Minnehaha County South Dakota.

ESN[A] In-furrow	Final Plant Population	Grain Yield
	No. /a	bu/a
No	158654	79.1
Yes	156787	78.8
Pr>F	0.56	0.75
Significance interpretation	No	No

[A] Environmentally Sensitive Nitrogen, (poly coated urea, 44-0-0)

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Effects of Late Season HYT-B (BSure, nutrients + amino acids) Application on Soybean and Corn Grain Yield

Anthony Bly* and Sara Berg
(SDSU Extension, Sioux Falls Regional Center)

SUMMARY

BSure applied at R3 growth stage did not significantly increase soybean or corn grain yield. Study details are presented in Tables 1, 2 and 3.

ACKNOWLEDGMENTS

Funding partially provided by South Dakota Soybean Research and Promotion Council, SDSU Extension, and South Dakota Ag. Experiment Station.

Table 1. Materials and Methods for in season HYT-B (BSure) near Garretson South Dakota in 2016.

Item	Description
Location	Minnehaha County, Garretson
Tillage	No-till
Variety (planting date)	Asgrow 14-28 (May 18)
Hybrid (planting date)	DKC 42-37 (May 4)
rotations	Corn/soybean
Row Spacing (inches)	Corn = 30 inches, soybean = 10 inches
B Sure rate	1 pt/a
What is HYT-B (BSure)?	Proprietary blend of nutrients (0.5-0-0.5) and I-amino acids
Application timing	Corn V8 and soybean R3 growth stages.
Carrier rate	Water at 15 gpa
Harvest method	Producer combine and weigh wagon.
Plot size	Approximately 90 x 600 ft
Replications	4
Statistics	ANOVA Pr>F mean separation

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Table 2. Influence of HYT-B (BSure) on soybean grain yield near Garretson SD in 2016.

B-Sure Treatment	Average Grain Yield (bu/a at 13% moisture)
No	69.7
Yes	72.9
Stats	
LSD (.05)	7.8 (non-significant)
CV	3.3
Pr>F	0.22

HYT-B (B-Sure) (1 pt/a) applied with 40 oz/a Roundup at R1 growth stage.
Soybean variety = Asgrow 14-28 (1.4 maturity group)
Large strip plots harvested with farmer's combine.

Table 3. Influence of HYT-B on corn grain yield near Garretson SD in 2016.

HYT-B Treatment	Average Grain Yield (bu/a at 15% moisture)
No	220.9
Yes	221.7
Stats	
LSD (.05)	4.1 (non-significant)
CV	0.53
Pr>F	0.47

HYT-B (1 pt/a) applied with 40 oz/a Roundup at V8 growth stage.
Corn hybrid = DKC 42-37
Large strip plots harvested with farmer's combine.

SOUTHEAST RESEARCH FARM ANNUAL REPORT
South Dakota State University
2016 Progress Report
Agricultural Experiment Station
Plant Science Department
South Dakota State University, Brookings, SD 57007
Southeast Research Farm, Beresford SD 57004

Influence of Several West Central Products on Soybean Grain Yield and Test Weight and R3 tri-foliate Leaf Nutrient Concentration at Southeast Research Farm near Beresford in 2016

Anthony Bly*, Sara Berg, and Brad Rops

Table 1. Materials and Methods

Item	Description
Planting date	5-20-16
Plot size	10ft x 30 ft
Soybean variety	Pioneer P15T46R2
Seeding rate	150,000 seeds/a
Row Spacing	7.5 inches
Tillage system	No-till
Treatment application date/growth stage	7-1-16, V6
Plant tissue sample date/growth stage	8-9-16, R3
Harvest date (plot combine)	9-27-16
Statistics (RCBD) 16 treatments	SAS

SUMMARY

- Grain yield treatment averages ranged from 48.1 to 56.6 bu/a with no statistically significant difference between treatments (Table 1).
- No significant treatment average differences were measured with grain test weight or plant tissue nutrient concentrations (Table 1).

ACKNOWLEDGEMENTS

This research project partially funded by West Central, SDSU Extension, South Dakota Agriculture Ag. Experiment Station, and Southeast Research Farm.

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Table 2. Influence of several West Central Products on Soybean grain yield and test weight and R3 tri-foliate leaf nutrient concentration at South Dakota Southeast Research Farm near Beresford in 2016.

			R3 tri-foliate leaf nutrient concentration									
Trt	Yield	Test wt	P	K	S	Ca	Mg	Zn	Fe	Mn	Cu	B
	bu/a	lbs/bu	%					ppm				
1	52.1	54.5	0.26	1.33	0.23	1.5	0.34	41.2	112.3	76.8	10.3	53.6
2	53.1	54.6	0.28	1.34	0.25	1.4	0.33	43.6	253.0	82.6	10.6	55.1
3	50.9	54.7	0.28	1.45	0.25	1.4	0.33	38.4	127.8	83.4	11.1	54.8
4	53.0	54.7	0.27	1.38	0.24	1.4	0.35	36.5	115.5	80.6	10.6	52.4
5	51.9	54.6	0.26	1.36	0.25	1.4	0.34	38.7	128.8	87.3	10.7	51.8
6	48.1	54.5	0.26	1.33	0.23	1.5	0.36	37.6	123.9	81.9	10.3	55.2
7	53.6	54.6	0.27	1.40	0.25	1.5	0.35	36.7	126.9	76.7	10.8	53.4
8	52.6	54.4	0.27	1.32	0.24	1.5	0.36	40.9	122.2	77.4	10.9	54.9
9	53.6	54.6	0.27	1.33	0.24	1.5	0.35	42.9	124.3	89.2	11.3	54.6
10	50.6	54.5	0.26	1.38	0.24	1.4	0.34	41.9	118.6	81.2	10.5	56.1
11	54.1	54.6	0.27	1.45	0.25	1.4	0.33	37.8	125.0	80.8	10.7	51.7
12	54.2	54.7	0.27	1.42	0.26	1.3	0.34	39.7	132.5	86.2	11.1	49.3
13	54.4	54.7	0.27	1.43	0.25	1.4	0.35	40.3	131.8	87.6	11.2	51.0
14	56.6	54.8	0.27	1.48	0.25	1.5	0.36	38.5	124.5	83.1	11.0	50.1
15	55.7	54.8	0.28	1.47	0.26	1.3	0.34	39.5	125.8	85.9	11.1	50.2
16	54.3	54.7	0.26	1.40	0.23	1.4	0.31	37.6	112.4	79.7	10.3	52.5
Stats:												
LSD(.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pr>F	0.917	0.825	0.967	0.583	0.893	0.638	0.641	0.859	0.575	0.785	0.892	0.265
CV	10.9	0.6	6.5	8.2	9.8	7.7	8.9	15.4	51.7	11.4	8.4	7.0

Treatment explanation: (applied at V6 growth stage, in 20 gallons water/acre)

1 = control
2 = Jackhammer (0.5 % v/v)
3 = Linkage (0.5 % v/v)
4 = Cerium Elite (0.25% v/v)
5 = WC101 16 oz/a
6 = WC101 (16 oz/a) + Jackhammer (0.5 % v/v)
7 = WC101 (16 oz/a) + Linkage (0.5 % v/v)
8 = WC101 (16 oz/a) + Cerium Elite (0.25% v/v)
9 = EB Mix (1 qt/a)
10 = EB Mix (1 qt/a) + Jackhammer (0.5 % v/v)
11 = EB Mix (1 qt/a) + Linkage (0.5 % v/v)
12 = EB Mix (1 qt/a) + Cerium Elite (0.25% v/v)
13 = WC101 16 oz/a + EB Mix (1 qt/a)
14 = WC101 16 oz/a + EB Mix (1 qt/a) + Jackhammer (0.5 % v/v)
15 = WC101 16 oz/a + EB Mix (1 qt/a) + Linkage (0.5 % v/v)
16 = WC101 16 oz/a + EB Mix (1 qt/a) + Cerium Elite (0.25% v/v)

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Influence of Boron, Copper and Manganese on Soybean and Corn Grain Yield at Several Locations in Eastern South Dakota in 2016.

Anthony Bly*, David Karki,
and Sara Berg

INTRODUCTION

Soybean and corn micro nutrient deficiency symptoms are rare to non-existent in eastern South Dakota. Zinc deficiency is more common in corn and in-frequently seen on poor, low organic matter and coarse texture soils. Corn responses to zinc applications have occurred when zinc soil test is below 1 ppm. Field research investigating the other micro-nutrients (Boron, Copper and Manganese) has been small. No visual boron, copper or manganese deficiencies have been recorded in South Dakota. However, much like zinc, soybean and corn could response to boron, copper and manganese field applications without the visual deficiency symptoms. For this reason, an on-farm research project was initiated to measure the influence of pre-emerge soil applications of boron, copper and manganese on soybean and corn yield in eastern South Dakota.

Table 1. Materials and Methods

Item	Description
Soybean locations	Crooks, Garretson, Arlington, Henry, NE Farm
Corn locations	Crooks, Garretson, Arlington, Henry, NE Farm
Boron rate and source	2 lbs B/a as Solubor
Copper rate and source	2 lbs Cu/a as copper sulfate
Manganese rate and source	20 lbs Mn/a as manganese sulfate
Application method/timing	Surface broadcast prior to crop emergence (pre-emerge)
Tillage methods	No-Till: Crooks, Garretson, Arlington
	Tillage: Henry, NE Farm
Pre-project soil samples	Composite 0-6 inch for each location analyzed for B,Cu and Mn.
Soybean row spacing (inches)	Crooks(15), Garretson(10), Arlington(7.5), Henry(30), NE farm (30)
Corn row spacing (inches)	All were 30.
Plot size	10 x 20 ft
Plot design	RCBD – randomized complete block design
Soil test level interpretations	EC-750, Fertilizer Recommendations Guide, SDSU
Replications	4
Statistics	ANOVA, Pr>F with treatment as dependent variable

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SUMMARY

Boron, copper and manganese soil test levels at all sites were in the high category (EC-750) except for boron at the Garretson site which was in the medium category (Table 2). No micro nutrient applications are recommended when soil levels are in the high category and 2 lbs/a boron are recommended for the medium category. Boron soil test levels ranged from 0.41 to 2.11 ppm. Copper soil test levels ranged from 0.76 to 2.44 ppm. Manganese soil test levels ranged from 5.9 to 40.0 ppm.

Grain yields at all sites were very good for soybeans and corn except corn at NE farm which had early season drought that reduced corn yield, however August rains helped soybean yields remain near average (Table 3 and 4). At all sites except for corn at NE farm, the micro nutrient treatment applications did not significantly influence soybean or corn grain yields (table 3 and 4). The early season drought at the NE farm possibly influence plot variability that resulted in creating the significant corn yield difference. Larger than normal numerical yield differences occurred at the Garretson and Arlington soybean sites and the Crooks and Garretson corn sites that may have appeared to indicated that micro nutrient applications are needed, however, statistical interpretation could not determine a meaningful difference.

ACKNOWLEDGMENTS

The soybean portion of this research work was partially funded by the South Dakota Soybean Research and Promotion Council. Other contributors were SDSU Extension, the South Dakota Ag. Experiment Station, the Northeast Research Farm, and many farmer cooperators.

Table 2. Pre-plant soil nutrient levels for born, copper and manganese at several locations in eastern South Dakota in 2016.

		Location				
Crop	Nutrient	Crooks	Garretson	Arlington	Henry	NE Farm
		ppm (soil test level)				
Soybeans	Boron	0.81 H	0.41 M	0.94 H	1.42 H	1.77 H
Soybeans	Copper	1.04 H	0.76 H	1.11 H	1.35 H	1.58 H
Soybeans	Manganese	20.0 H	5.9 H	13.5 H	39.0 H	31.6 H
Corn	Boron	0.90 H	0.82 H	1.68 H	2.11 H	1.02 H
Corn	Copper	2.24 H	0.81 H	1.06 H	1.75 H	0.86 H
Corn	Manganese	22.5 H	14.1 H	11.5 H	40.0 H	22.1 H

Soil test levels: L=low, M=medium, H=high

Table 3. Influence of boron, copper and manganese on soybean grain yield at several locations in eastern South Dakota during 2016.

Nutrient	Crooks	Garretson	Arlington	Henry	NE Farm
	-- bu/a ---				
Control	60.6	52.4	56.1	51.4	48.1
Boron (B)[A]	61.3	55.8	56.6	49.3	48.4
Copper (Cu)[B]	61.3	56.1	60.9	46.5	48.5
Manganese (Mn)[C]	61.0	57.1	62.2	46.8	48.8
CV %	4.0	9.5	8.1	16.7	6.4
Pr>F	0.98	0.72	0.23	0.81	0.99
LSD (.05)	NS	NS	NS	NS	NS

[A] 2 lbs B/a surface broadcast spread as Solubor before crop emergence.
[B] 2 lbs Cu/a surface broadcast spread as copper sulfate before crop emergence.
[C] 20 lbs Mn/a surface broadcast spread as manganese sulface before crop emergence.

Table 4. Influence of boron, copper and manganese on corn grain yield at several locations in eastern South Dakota during 2016.

Nutrient	Crooks	Garretson	Arlington	Henry	NE Farm[D]
	-- bu/a ---				
Control	190.1 b	218.6	162.6	228.3	69.1 b
Boron (B)[A]	183.6 b	218.5	153.4	216.2	68.7 b
Copper (Cu)[B]	200.1 a	211.1	154.0	207.6	81.4 a
Manganese (Mn)[C]	189.4	225.5	156.3	216.8	74.1 ab
CV %	3.0	5.8	24.9	5.3	7.6
Pr>F	0.02	0.49	0.99	0.25	0.02
LSD (.05)	NS	NS	NS	NS	8.6

[A] 2 lbs B/a surface broadcast spread as Solubor before crop emergence.
[B] 2 lbs Cu/a surface broadcast spread as copper sulfate before crop emergence.
[C] 20 lbs Mn/a surface broadcast spread as manganese sulface before crop emergence.
[D] extreme drought conditions reduce corn yield

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Influence of Late Season Stratego Application on Soybean Yield in Eastern South Dakota in 2016

Sara Berg, Anthony Bly, David Karki, and Connie Strunk*

INTRODUCTION

Fungicides can be effective in controlling fungal diseases in soybeans. However, response to fungicide application is most likely when there is a significant disease pressure. There is a need to test different fungicides in order to recommend to producers the likelihood of obtaining a profitable return on fungicide investment in soybeans. The objective is to determine the efficacy of foliar fungicides (Stratego) in controlling soybean fungal diseases.

MATERIALS AND METHODS

Treatments listed in Table 1 are applied as below. Each location had untreated check plots (no fungicide applied) versus plots treated with fungicide (Stratego). Stratego's active ingredients are Propiconazole, 11.4% (CAS No. 60207-90-1) and Trifloxystrobin, 11.4% (CAS No. 141517-21-7). Important to note, soybean disease pressure was very low to non-existent at each location.

Table 1. Materials and Method

Item	Description
Late season growth stage, Stratego application	R3
Locations	Crooks, Garretson, Arlington, Henry, and South Shore
Stratego rate	4 oz/a
Carrier volume	15 gpa water
Plot size	10 ft x 20 ft
Replications/location	4
Randomization	RCBD (randomized complete block design)
Statistics	ANOVA, Pr>F, treatment as independent variable
Harvest method	Small plot combine

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RESULTS AND DISCUSSION

No significant differences were found when fungicides were applied. There was about a half bushel difference between the fungicide treated plots and the untreated check plots.

SUMMARY

Disease pressure was very low to non-existent at each location. Fungicide results indicated there were no significant differences found when fungicides were applied.

ACKNOWLEDGMENTS

Funding for this research project was provided by the South Dakota Soybean Research and Promotion Council, SDSU Extension, SD Agriculture Experiment Station and the Northeast Research Farm near South Shore SD. The authors would also like to thank the soybean producers who participated in this project.

Table 2. Influence of late season fungicide application on soybean yield at various locations in South Dakota during 2016.

Treatment	Location					
	Crooks	**Garretson**	**Arlington**	**Henry**	**South Shore**	Grand Mean
	bu/a					
Control	63.9	51.9	57.1	50.3	49.5	54.7
Stratego[A]	64.2	51.2	58.5	50.1	50.3	55.3
Pr>F	0.89	0.86	0.78	0.92	0.80	0.80
CV (%)	4.2	8.1	11.6	5.1	9.6	12.7
LSD(.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

[A] 4 oz/a applied at R3 growth stage.
NS = non-significant difference.

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Instinct II, Agrotain Ultra, and Nitrogen Management Effect on Wheat Cereal Grain Yield

Sara Berg*, Anthony Bly, David Karki

Nitrogen (N) additives to control N losses through volatilization, denitrification, and leaching are widely used in the Midwest, particularly with surface application of urea in wet springs. Slowing conversion of fertilizer products to nitrate may lessen leaching and denitrification losses if precipitation or soil water content is high. Urease inhibitors slow the conversion of urea to ammonia, lessening potential volatilization losses. Long term yield and economic response to these additives is highly dependent on the amount and timing of precipitation events. Therefore, a wheat nitrogen management study was conducted to evaluate the influence of Instinct II (nitrapyrin- nitrification inhibitor) and Agrotain Ultra (N-(n-butyl)-thiophosphoric triamide- volatilization reducer) on wheat grain yield.

Table 1. Materials and Methods

Item	Description
Previous crop/tillage	Oat/ no-till
Begin nitrate-N soil test (0-2ft depth)	SW[1]: 30 lbs/a 0-2'; WW: 66 lbs/a N 0-2'
Plot size	SW: 20'x200'; WW Urea[2]: 20'x200'; WW UAN[3]: 15'x200'
Variety	SW: Forefront; WW: Expedition
Seeding Rate	SW: 110#/a; WW: 120#/a
Planting date	SW: 4/15/16; WW: 10/6/15
Other fertilizer applied	SW: 100 lbs/a 11-52-0; WW: 100 lbs/a 11-52-0
Treatments	Tables 2, 3, and 4
Nitrogen sources	SW: Urea; WW: Urea/UAN
Nitrogen application date Pre-plant	SW: 11/9/15, 4/13/16; WW Urea: 10/6/15; WW UAN: 10/6/15
Side dress N application date	WW Urea: 4/13/16; WW UAN: 4/13/16
Side dress N application method	WW Urea: Gandy spreader; WW UAN: Stream bar application
Harvest Date	SW: 7/26/16; WW:7/14/16
Replications	3
Experimental design	Randomized Complete Block Design

[1] 'SW' refers to the spring wheat study of 2016.
[2] 'WW Urea' refers to the winter wheat with urea study of 2016.
[3] 'WW UAN' refers to the winter wheat with UAN study of 2016.

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Table 2. Effects of Instinct II with urea on spring wheat in 2016 at the SDSU Southeast Research Farm near Beresford, SD.

----------------------------Treatment------------------------------					Protein[4]	Test Wt.	Stand	Yield[4]
	--------N (%)--------		--Instinct II (oz/a)[3]--					
	Pre-plant[1]	Top-dress[2]	Pre-plant	Top-dress	%	lb/bu	plants/ac	bu/ac
1	0				13.0	61.8	76	32.3
2	100				12.9	61.9	68	39.4
3	100		37		13.1	61.4	81	46.7
4	70				14.0	61.4	60	40.2
5	70		37		13.4	61.7	54	43.3
6		100			13.8	61.5	61	44.8
7		100		37	13.1	57.7	57	47.8
8		70			13.1	60.2	54	33.1
9		70		37	13.8	61.5	66	38.0
CV					3.19	1.79	33.3	22.3
Pr>F					0.047	0.006	0.768	0.395

[1]Pre-plant surface broadcast dry fertilizer application of 46-0-0 on 11/9/15.
[2]Top-dress surface broadcast dry fertilizer application of 46-0-0 on 4/13/16.
[3]Instinct II is a nitrogen stabilizer product made with nitrapyrin.
[4]Grain protein and yield adjusted to 13% moisture.

Table 3. Effects of Instinct II and Agrotain Ultra with urea on winter wheat in 2016 at the SDSU Southeast Research Farm near Beresford, SD.

------------------------------Treatment------------------------------					Protein[5]	Test Wt.	Stand 1	Stand 2	Yield[5]
	-------N (%)-------		---Product Applied[3,4]---				11/10/15	4/25/16	
	Pre-plant[1]	Top-dress[2]	Pre-plant	Top-dress	%	lb/bu	plants/ac	plants/ac	bu/ac
1	0				11.8	58.0	36.0	39.3	41.34
2	100				12.0	58.9	38.0	39.7	38.82
3	100		I		12.4	58.1	42.0	45.3	42.88
4	100		A		11.9	59.3	41.7	45.3	40.23
5	70				12.6	58.0	39.3	41.7	42.49
6	70		I		12.6	58.2	39.0	41.0	42.22
7	50	50			12.2	58.3	39.7	42.0	42.99
8	50	50	I		11.9	59.5	38.7	42.3	42.23
9	50	50		I	12.5	58.4	46.7	48.3	39.79
10	50	50	A		12.5	58.6	44.3	45.3	41.24
11	50	50	I&A		12.4	59.0	41.3	42.0	42.20
CV					3.59	1.68	18.0	16.0	6.02
Pr>F					0.268	0.541	0.863	0.877	0.559

[1]Pre-plant surface broadcast dry fertilizer application of 46-0-0 on 10/6/15.
[2]Top-dress surface broadcast dry fertilizer application of 46-0-0 on 4/13/16.
[3]Two products were applied with urea. ‘I’ is Instinct II- applied at 37 oz/a; ‘A’ is Agrotain Ultra- applied at 3 qts/ton.
[4]Instinct II is a nitrogen stabilizer product made with nitrapyrin; Agrotain Ultra is a urease inhibitor product made with NBPT (N-(n-butyl)-thiophosphoric triamide).
[5]Grain protein and yield adjusted to 13% moisture.

Table 4. Effects of Instinct II and Agrotain Ultra with UAN[1] on winter wheat in 2016 at the SDSU Southeast Research Farm near Beresford, SD.

	Treatment				Protein[6]	Test Wt.	Stand 1	Stand 2	Yield[6]
	-------N (%)------		--Product Applied[4,5]--				11/10/15	4/25/16	
	Pre-plant[2]	Top-dress[3]	Pre-plant	Top-dress	%	lb/bu	plants/ac	plants/ac	bu/ac
1					11.7	58.0	49.7	51.7	46.62
2	100				11.5	59.4	43.3	45.7	43.80
3	100		I		12.3	58.7	37.7	40.3	43.50
4	100		A		11.4	59.0	39.3	41.0	37.25
5	70				11.2	58.7	45.0	45.3	41.50
6	70		I		11.8	59.5	39.3	41.0	44.38
7	50	50			11.7	58.9	35.0	37.7	38.42
8	50	50	I		12.3	58.5	47.0	47.0	38.09
9	50	50		I	12.6	59.7	36.3	39.0	39.78
10	50	50	A		12.4	59.5	38.7	41.3	42.62
11	50	50	I&A		12.5	58.5	39.0	42.0	45.85
CV					3.59	1.68	18.0	16.0	6.02
Pr> F					0.268	0.541	0.863	0.877	0.559

[1]UAN is urea-ammonium nitrate or 28-0-0
[2]Pre-plant surface liquid fertilizer application of 28-0-0 (UAN) on 10/6/15.
[3]Top-dress surface liquid fertilizer application of 28-0-0 on 4/13/16.
[4]Two products were applied with UAN. ‘I’ is Instinct II- applied at 37 oz/a; ‘A’ is Agrotain Ultra- applied at 1.5 qts/ton.
[5]Instinct II is a nitrogen stabilizer product made with nitrapyrin; Agrotain Ultra is a urease inhibitor product made with NBPT (N-(n-butyl)-thiophosphoric triamide).
[6]Grain protein and yield adjusted to 13% moisture.

SUMMARY

The 2016 growing season brought temperate weather and excessive early rainfall followed by average rainfall at the Southeast (SE) Research Farm. Across three studies carried out at the SE Research Farm (i.e. spring wheat with urea, winter wheat with urea, and winter wheat with UAN), there were no significant differences between treatment yields. The obtained results could be attributed to multiple factors; however, it is very likely that heavy rains in the early spring leading to waterlogged soils might have lessened the impacts of N management products. Significant differences in cereal grain protein and test weight were observed between the applied treatments in the spring wheat trial (Table 2). This research will be replicated in the 2017 cropping season.

ACKNOWLEDGMENTS

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2016 Corn Foliar Fungicide Trials

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and Emmanuel Byamukama

INTRODUCTION

Corn foliar diseases can cause substantial yield losses and negatively impact grain quality. Some of the corn leaf diseases in South Dakota include gray leaf spot (*Cercospora zeae maydis*), common rust (*Puccinia sorghi*), southern rust (*Puccinia polysora*), anthracnose (*Colletotrichum graminicola*) eyespot (*Aureobasidium zeae*) and northern corn leaf blight (*Exserohilum turcicum*). This foliar disease may escalate crop susceptibility to stalk rots such as gibberella stalk rot (*Gibberella zeae*), fusarium stalk rot (*Fusarium spp*) and anthracnose stalk rot (*Colletotrichum graminicola*), consequently triggering ear rots and lodging. The extent of disease severity is a direct result of cultural practices, presence of inoculum, favorable weather conditions for pathogen establishment and survival and inherent lack of host resistance. Thus, any one of these diseases can attack corn at any time dependending on pathogen life cycle in a given corn production season.

Fungicides are sometimes used to effectively manage corn foliar diseases. Fortunately, corn foliar diseases occur more sporadically in South Dakota than in other states and therefore return on fungicide investment in corn may not be realized often. Most of these diseases are, therefore, not a major threat to corn production in the state.

The major biotic problem at Volga for the 2016 growing season was goss's wilt (*Clavibacter michiganensis* subsp. *nebraskensis*) while common stalk rot was the main disease in our plots at Southeast Research Farm (SERF). For the most part, when these diseases occur, they scarcely cause economic injury. However, generation of information on the efficacy of fungicides and optimal application time are critical for future use, particularly in cases where foliar fungal diseases develop with potential devastating impact on yield. The studies in this report aimed at testing the efficacy of several fungicide products at different growth stages to control fungal pathogens of corn.

MATERIALS AND METHODS

A corn cultivar, 38N85 from Pioneer hybrid, was planted to both the Foliar Fungicide and the Uniform Foliar Fungicide studies at 35,000 plants/acre at Volga and SERF near Beresford, SD.

The trials were planted in randomized complete blocks (RCBD) with four blocks or replicates of each treatment per location. Experimental plots were planted, rated and harvested on the dates listed in Table 1. Fungal foliar disease assessments, % of green tissue left, lodging, stalk rot and yield were done. Products for controlling foliar fungal diseases were applied at varying rates at V5, V6, V6 - V8, VT and R1 in both studies.

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RESULTS AND DISCUSSION

1.0 Foliar Fungicide Study
Volga & SERF

Although no significant differences were observed at the Volga location for all analyzed traits, the numerical differences between plots to which Stratego YLD (2fl oz/A, at V5) was applied and plots that were left untreated was 22.9 lb/A (0.37 bu/A). This may be attributed to other factors other than control of disease since there was very low disease pressure. Small or lack of significant differences could also be attributed to the occurrence of Goss's wilt might have confounded the results from this location (Table 1.1).

At Southeast Research Farm, no significant differences were observed for any of the measured variables. The differences between treated and the control were probably due to chance or micro-environmental factors (Table 1.2).

2.0 Uniform Foliar Fungicide Study
Volga & SERF

Talk rot was high in untreated plots compared to plots that were sprayed with a fungicide in this trial. Fortix (5 fl oz/A, at both V6 and VT) and Quilt Xcel (10.5 fl oz/A) had significantly less plants with stalk rot compared to the untreated control. No differences between treated and untreated plots for test weight and lodging, however, Quilt Xcel (10.5 fl oz/A, at VT) produced the highest yield and was the only yield value that was significantly different from the check. Fortix (5 fl oz/A, at VT also produced yield that was significantly different from the control (Table 2.1).

At Southeast Farm (Table 2.2), there were no significant differences for yield except Headline AMP (10 fl oz/A, at V6). However, the numerical differences suggest that spraying a fungicide had an impact on yield, especially considering that the untreated plots were prone to rusts, stalk rot and lodging. Thus, all treated plots were significantly differently from the untreated plots in terms of common rusts, stalk rot and lodging.

These results reiterate the importance of incorporating fungicide products in IPM strategies if disease severity threatens to approach economic thresholds.

ACKNOWLEDGEMENTS

Studies were supported in part by SDSU Agricultural Experiment Station and collaborative private industry corporations.

Table 1. Dates for planting, plot evaluations, and harvest at study locations.

Operation	Date of operation by location	
	SE Research Farm	Volga Research Farm
Planting	5/19/2016	5/6/2016
Disease Ratings	8/8/2016	8/10/2016
	8/25/2016	8/24/2016
	9/12/2016	9/19/2016
Harvest	10/27/2016	11/3/2016

Table 1.1 Corn foliar fungicide trial product, rate, application stage, and mean difference for yield, disease ratings and quality associated with various foliar treatments at Volga research farm, SD for the 2016 season. All values are contrasted with the untreated check.

Treatment; rate (fl oz/A)	Growth stage	Yield (lb/A)	P-value	Goss's wilt Incidence (%)	P-value	Goss's wilt Severity (1-9)‡	P-value	Test Weight (lb/bu)	P-value	Lodging (%)	P-value
Stratego YLD; 2	V5	22.90†	0.479	6.4	0.996	0.0	1.000	0.226	0.99	-0.06	1.00
Experimental A; 3.5	V5	14.77	0.873	10.0	0.938	0.8	0.999	0.294	0.99	-0.02	1.00
Experimental A; 4.5	V5	17.22	0.766	-3.4	1.000	2.8	0.737	-0.930	0.28	-0.42	0.98
Stratego YLD; 4	VT	18.47	0.705	11.2	0.892	2.6	0.798	0.054	1.00	0.00	1.00
Experimental A; 7	VT	-6.65	0.999	20.2	0.354	5.8	0.074	-0.432	0.93	0.02	1.00
Experimental A; 9	VT	16.21	0.814	1.0	1.000	-0.4	1.000	0.272	0.99	0.02	1.00
Zolera FX 3.34 SC; 5	VT	-2.57	1.000	6.0	0.997	2.6	0.798	0.044	1.00	0.00	1.00
Trivapro; 10	V6-V8	7.69	0.997	14.6	0.699	4.8	0.191	0.336	0.98	0.04	1.00
Trivapro; 10	VT-R1	7.92	0.997	5.0	0.999	3.4	0.541	0.056	1.00	-0.02	1.00

†The means represent a difference between the treated plots with the particular treatment and untreated plots

‡Goss's wilt severity where 1=10% and 9=90% severity

Table 1.2 Corn foliar fungicide trial product, rate, application stage, and mean difference for yield, disease ratings and quality associated with various foliar treatments at Southeast research farm, SD for the 2016 season. All values are contrasted with the untreated check.

Treatment; rate (fl oz/A)	Growth stage	Yield (lb/A)	P-value	Lodging (%)	P-value	Stalk rot (%)	P-value	Test Weight (lb/bu)	P-value
Stratego YLD; 2	V5	3.58[†]	1.0000	0.37	0.6295	0.17	1.0000	0.16	0.9583
Experimental A; 3.5	V5	-2.93	1.0000	0.00	1.0000	-0.84	0.9998	0.13	0.9870
Experimental A; 4.5	V5	-15.20	0.6568	0.00	1.0000	1.92	0.9501	0.30	0.5090
Stratego YLD; 4	VT	-6.16	0.9969	0.00	1.0000	0.89	0.9997	-0.05	1.0000
Experimental A; 7	VT	-20.41	0.3394	0.00	1.0000	-1.25	0.9967	0.23	0.7605
Experimental A; 9	VT	2.32	1.0000	0.00	1.0000	-1.78	0.9677	-0.09	0.9993
Zolera FX 3.34 SC; 5	VT	-2.45	1.0000	0.00	1.0000	0.91	0.9997	0.10	0.9982
Trivapro; 10	V6-V8	4.11	0.9999	0.44	0.4313	-2.19	0.9022	-0.07	0.9998
Trivapro; 10	VT-R1	-3.75	0.9999	0.00	1.0000	-1.78	0.9675	0.09	0.9990

[†]The means represent a difference between the treated plots with the particular treatment and untreated plots

Table 2.1 Corn uniform foliar fungicide trial product, rate, application stage, and mean difference for yield, disease ratings and quality associated with various foliar treatments at Volga research farm, SD for the 2016 season.

Treatment; rate (fl oz/A)	Growth stage	Stalk rot (%)	P-value	Lodging (%)	P-value	Test weight (lb/bu)	P-value	Goss's Severity (1-9)	P-value	Yield (lb/A)	P-value
Headline AMP; 10	V6	-3.25[†]	0.051	-0.90	0.9615	-0.22	0.8867	-2.25	0.163	19.12	0.254
Fortix; 5	V6	-3.81	0.020	-2.58	0.3426	0.17	0.9554	-2.75	0.069	13.55	0.549
Headline AMP; 10	VT	-1.06	0.826	-0.40	0.9989	-0.08	0.9983	-3.75	0.011	17.04	0.348
Fortix; 5	VT	-3.81	0.020	-1.15	0.9045	-0.02	1.0000	-3.25	0.027	28.62	0.048
Quilt Xcel; 10.5	VT	-3.81	0.020	-2.13	0.5118	0.54	0.2332	-2.00	0.242	35.92	0.012

[†]The means represent a difference between the treated plots with the particular treatment and untreated plots

Table 2.2 Corn uniform foliar fungicide trial product, rate, application stage, and mean difference for yield, disease ratings and quality associated with various foliar treatments at Southeast research farm, SD for the 2016 season. All values are contrasted with the untreated check.

Treatment; rate (fl oz/A)	Growth stage	Rust (%)	P-value	Test Weight (lb/bu)	P-value	Stalk rot (%)	P-value	Lodging (%)	P-value	Yield (lb/A)	P-value
Headline AMP; 10	V6	-1.53[†]	0.0007	-0.04	0.9995	-4.61	0.0011	-1.55	0.4158	31.38	0.0304
Fortix; 5	V6	-1.40	0.0015	0.20	0.6598	-3.05	0.0263	-1.13	0.6882	21.19	0.1895
Headline AMP; 10	VT	-1.78	0.0001	-0.25	0.4762	-4.61	0.0011	-1.13	0.6882	22.43	0.1541
Fortix; 5	VT	-1.58	0.0005	-0.10	0.9682	-4.36	0.0018	-2.10	0.1773	19.34	0.2544
Quilt Xcel; 10.5	VT	-0.98	0.0239	-0.17	0.7760	-4.61	0.0011	-2.78	0.0519	24.53	0.1073

[†]The means represent a difference between the treated plots with the particular treatment and untreated plots

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2016 SOYBEAN FOLIAR FUNGICIDE AND CYST NEMATODE TRIALS

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INTRODUCTION

Soybean, like most agricultural crops, suffers from biotic stresses both above and below ground. Most of the foliar diseases of soybean are caused by fungal pathogens, a few are caused by viruses and bacteria. Although South Dakota has rarely experienced soybean foliar diseases with major economic impact in recent times, there are some common diseases that sporadically appear in soybean fields. Such diseases include White mold (*Sclerotinia sclerotiorum*), Septoria leaf spot (*Septoria glycines*), Cercospora blight and purple seed stain (*Cercospora kikuchii*), Frogeye leaf spot (*Cercospora sojina*) and Downy mildew (*Peronospora manshurica*).

White mold and Septoria leaf spot (Brown spot) are the most commonly observed diseases and therefore are diseases of interest in South Dakota. Brown spot appears in almost every field annually at varying degrees of severity. Heavy crop canopies tend to favor soybean foliar disease development, especially when weather conditions are wet and humid. The brown spot pathogen survives in crop residues and can be spread from infected residues to soybean leaves by splashing rain drops. Soybean plants infected by other diseases or compromised by environmental conditions may easily succumb to brown spot. Unless premature defoliation occurs in the mid and upper canopy during critical reproductive stages, brown spot does not cause significant yield losses.

White mold favors wet, cool conditions during flowering. Wet weather and temperatures from 68 to 78 degrees F are ideal for white mold development. The disease can cause yield losses of up 50% and diminish seed quality. White mold, much like most of the plant diseases can be efficiently managed by implementing long term production methods such as cultivar selection, effective weeds managements as well as crop rotation.

The soybean cyst nematode (SCN) (*Heterodera glycines*) is one of the most damaging diseases in soybeans in the US. SCN is a microscopic round worm that accumulate in the soil to high levels in a relatively short time. By the time the nematode population density is sufficient to cause above-ground symptoms on crops, significant yield losses are already occurring and it will also be difficult to bring down the SCN population density. Therefore, monitoring SCN numbers in the soil is essential to for effective SCN management and prevention of population build up. The objective of this study was to evaluate the efficacy of new and potential fungicides as well as nematicides to control foliar diseases and cyst nematodes in soybeans.

MATERIALS AND METHODS

The foliar fungicide experiments were planted in randomized complete blocks (RCBD) with four

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replicates per location. The plots were planted, rated and harvested on the dates indicated in Table 1.

Syngenta S17-B3 was planted at 150,000 seeds/acre at the Southeast Research Farm (SERF) near Beresford, SD and at the SDSU Experiment Farm at Volga for the foliar fungicide treatment trial.

Plants were rated for fungal foliar diseases, yield and test weight. Multiple comparisons of treatment means (LS-means) were reported using the Tukey-Kramer grouping approach, $\alpha = 0.05$.

In the SNC Study, S10-P9 and S12-H2 were used in a split-plot arranged trial in a randomized complete block design at Hurley and Southeast Farm for the SCN demonstration study I. H16-R6 and H20-R3 were used in a similar study, SCN demonstration II. Initial population counts were done at V5 while late population counts were collected at physiological maturity (R8). Yield, test weight and protein and oil contents were determined at the harvest.

Table 1. Dates for planting, plot evaluations, and harvest at various locations.

Activity	Date of activity by location		
	SE Research Farm	Volga Research Farm	Hurley
Planting:			
Foliar Fungicide	6/8/2016	5/18/2016	___
SCN Demo I+II	5/20/2016	___	6/2/2016
Final disease rating:			
Foliar Fungicide	8/29/2016	8/12/2016	___
Foliar Fungicide	9/9/2016	8/29/2016	___
Harvest:			
Foliar Fungicide	10/25/2016	10/18/2016	___
SCN Demo I+II	10/10/2016	___	10/24/2016

RESULTS AND DISCUSSION

Foliar Fungicide Trial

VOLGA & SERF

This study was established to determine the efficacy of various foliar fungicides in managing fungal diseases of soybean. The 2016 season saw very low disease prevalence both at Volga and SERF locations.

Observations at Volga did not show significant differences for yield and test weight mainly due to low disease pressure even in the non-treated plots (<1%). Nevertheless, untreated plots exhibited higher Brown spot and Frog eye disease severity than plots that were sprayed with a fungicide. However, the differences were not pronounced enough to bear practical implications (Table 1.1).

There were no significant differences in yield, test weight and Frog eye at SERF. However, significant differences were observed for Brown spot where the untreated plots had a higher disease severity compared to plots to which a fungicide was applied (Table 1.2).

Table 1.1 Means for yield, test weight, brown spot and frog eye for the Foliar Fungicide Study at Volga, SD for 2016.

Treatment; rate (fl oz/A)[†]	**Yield (lb/A)**	**Test weight (lb/bu)**	**Brown spot (%)**	**Frog eye (%)**
Untreated	65.71 *a*[†]	55.73 *a*	0.70 *a*	0.76 *a*
Quadris; 6.2	67.06 *a*	55.70 *a*	0.00 *b*	0.00 *b*
Tilt; 4	63.69 *a*	55.94 *a*	0.00 *b*	0.00 *b*
Stratego YLD; 4	67.16 *a*	55.37 *a*	0.00 *b*	0.00 *b*
Monsoon; 3	64.00 *a*	55.67 *a*	0.00 *b*	0.00 *b*
Priaxor; 8	67.20 *a*	55.49 *a*	0.00 *b*	0.00 *b*
Fortix; 4	65.59 *a*	55.62 *a*	0.00 *b*	0.10 *b*
Aproach prima; 5	67.79 *a*	55.91 *a*	0.00 *b*	0.00 *b*
Bravo Weather Stik; 1.5	66.66 *a*	56.00 *a*	0.00 *b*	0.20 *ab*
Sonata; 1	62.56 *a*	55.72 *a*	0.00 *b*	0.00 *b*
Cuproxat; 3.9	63.32 *a*	55.63 *a*	0.00 *b*	0.00 *b*
Domark 230 ME; 4	61.22 *a*	55.79 *a*	0.00 *b*	0.00 *b*
Trivapro (A 4.1 oz/A + B 10.5); 10	66.62 *a*	55.79 *a*	0.00 *b*	0.00 *b*
Zolera FX 3.34 SC; 5	71.16 *a*	55.47 *a*	0.00 *b*	0.00 *b*

[†]Means followed by the same letter are not significantly different, α=0.05

Table 1.2. Means for yield, test weight, brown spot and frog eye for the Foliar Fungicide Study at Southeast Rresearch Farm near Beresford, SD for 2016.

Treatment; rate (fl oz/A)	Yield (lb/bu)	Test Weight (lb/bu)	Brown spot (%)	Frog eye (%)
Untreated	66.65 *a*[†]	55.29 *a*	2.24 *A*	0.40 *a*
Quadris; 6.2	67.59 *a*	55.45 *a*	0.00 *B*	0.20 *a*
Tilt; 4	63.84 *a*	55.68 *a*	0.00 *B*	0.00 *a*
Stratego YLD; 4	70.67 *a*	55.39 *a*	0.00 *B*	0.00 *a*
Monsoon; 3	64.78 *a*	55.53 *a*	0.20 *Ab*	0.00 *a*
Priaxor; 8	66.87 *a*	55.20 *a*	0.60 *Ab*	0.00 *a*
Fortix; 4	68.05 *a*	55.67 *a*	0.00 *B*	0.00 *a*
Aproach prima; 5	67.96 *a*	55.36 *a*	0.00 *B*	0.10 *a*
Bravo Weather Stik; 1.5	66.36 *a*	55.76 *a*	0.10 *b*	0.00 *a*
Sonata; 1	62.26 *a*	55.81 *a*	0.40 *ab*	0.00 *a*
Cuproxat; 3.9	65.75 *a*	55.89 *a*	0.50 *ab*	0.00 *a*
Domark 230 ME; 4	66.04 *a*	55.39 *a*	0.00 *b*	0.20 *a*
Trivapro (A 4.1 oz/A + B 10.5); 10	64.82 *a*	55.83 *a*	0.00 *b*	0.00 *a*
Zolera FX 3.34 SC; 5	65.83 *a*	55.53 *a*	0.00 *b*	0.00 *a*

[†]Means followed by the same letter are not significantly different, α=0.05

2.0 Soybean Cyst Nematode Demonstration I

SERF and Hurley

Three nematicides were evaluated on two cultivars (S10-P9 and S12-H2) to assess the impact of the nematicide treatments on SCN soil population and ability to prevent the negative effect of SCN on grain yield. At the beginning of the season, an initial SCN population was collected and was later used as a covariate in the final data analyses.

At SERF, Activa Complete Beans 500 (0.2419 mg A/Seed) had the highest fall SCN numbers which was significantly different from all treatments including the untreated plots, except CruiseMaxx-Vibrance (0.0945 mg A/Seed) for S10-P9. This may be attributed to the high variability of SCN in the field rather than effect of the treatment. No differences were observed for S12-H2 for fall SCN numbers and yield. Although there were no significant differences among treatments within a cultivar, the SCN resistant cultivar (S12H2) yielded generally higher than the susceptible cultivar. However, a negative correlation between yield and fall SCN numbers was observed, $r = -0.39$, $p=0.012$ indicating a negative impact of high SCN numbers on yield. Observed differences in stand counts and test weight could not, unequivocally, be attributable to treatment (Table 2.1).

At Hurley, Activa Complete Beans 500 (0.2419 mg A/Seed) had the highest fall SCN numbers that were significantly different from anyone of the treatments including the untreated check in S10-P9. Again, this is an indication of random variability of SCN rather than the effect of the treatment. There were yield differences whereby the untreated plots generally produced lower bushels than treated plots in S10-P9, irrespective of fall SCN numbers. Similarly, untreated plots were not significantly different from any of the treatments for initial/early stand counts (Table 2.2). As at Beresford location, the SCN resistant cultivar yielded better than the susceptible cultivar.

Table 2.1. 2016 Soybean Cysts Nematode (SCN) Demonstration I: Fall SCN numbers, yield, early and final stand counts and test weight associated with various seed treatments at Southeast Research Farm near Beresford, SD.

Cultivar	Treatment	Fall SCN numbers	Yield (lb/A)	Early stand count (plants/A)	Final stand count (plants/A)	Test weight (lb/bu)
S10P9	Untreated	2575 *b*†	53.74 *ab*	58542 *b*	78692 *a*	55.99 *Ab*
S10P9	CruiserMaxx Vibrance; 0.0945 mg A/Seed	2837 *ab*	51.24 *ab*	64805 *ab*	78692 *a*	56.25 *Ab*
S10P9	Activa Complete Beans 500; 0.2419 mg A/Seed	5350 *a*	50.25 *ab*	75152 *a*	82232 *a*	56.09 *Ab*
S10P9	CruiseMaxx Vibrance+ Clariva PN; 2 fl oz/cwt	1487 *b*	45.34 *b*	63988 *ab*	78420 *a*	56.25 *Ab*
S10P9	Illevo; 1.18 fl oz/140000 seeds	2337 *b*	46.59 *b*	55547 *b*	86044 *a*	56.25 *Ab*
S12H2	Untreated	1287 *b*	56.95 *ab*	55819 *b*	77875 *a*	56.07 *Ab*
S12H2	CruiserMaxx Vibrance; 0.0945 mg A/Seed	987 *b*	60.07 *a*	60176 *ab*	75697 *a*	56.51 *A*
S12H2	Activa Complete Beans 500; 0.2419 mg A/Seed	662 *b*	60.07 *a*	52007 *b*	74879 *a*	54.19 *B*
S12H2	CruiseMaxx Vibrance+ Clariva PN; 2 fl oz/cwt	2675 *b*	59.99 *a*	53913 *b*	76241 *a*	56.25 *Ab*
S12H2	Illevo; 1.18 fl oz/140000 seeds	537 *b*	57.75 *ab*	63716 *ab*	81959 *a*	55.94 *Ab*

†Means followed by the same letter are not significantly different, α=0.05

Table 2.2. 2016 Soybean Cysts Nematode (SCN) Demonstration I: Fall SCN numbers, yield, early and final stand counts and test weight associated with various seed treatments at Hurley, SD.

Cultivar	Treatment	Fall SCN numbers	Yield (lb/A)	Early stand counts (plants/A)	Final stand counts (plants/A)	Test weight (lb/bu)
S10P9	Untreated	9038 *b*[†]	42.02 *d*	66711 *ab*	86043 *a*	54.37 *c*
S10P9	CruiserMaxx Vibrance; 0.0945 mg A/Seed	7425 *b*	44.36 *cd*	69161 *a*	89311 *a*	54.59 *c*
S10P9	Activa Complete Beans 500; 0.2419 mg A/Seed	61679 *a*	44.50 *cd*	71158 *a*	81398 *a*	54.48 *c*
S10P9	CruiseMaxx Vibrance+ Clariva PN; 2 fl oz/cwt	4600 *b*	49.99 *ab*	70523 *a*	89856 *a*	54.73 *bc*
S10P9	Illevo; 1.18 fl oz/ 140000 seeds	8476 *b*	44.69 *bcd*	69343 *a*	101397 *a*	54.37 *c*
S12H2	Untreated	1775 *b*	50.31 *ab*	67528 *ab*	99409 *a*	55.39 *a*
S12H2	CruiserMaxx Vibrance; 0.0945 mg A/Seed	3902 *b*	48.89 *abc*	57453 *b*	94265 *a*	55.41 *a*
S12H2	Activa Complete Beans 500; 0.2419 mg A/Seed	2900 *b*	50.65 *a*	67255 *ab*	101291 *a*	55.17 *ab*
S12H2	CruiseMaxx Vibrance+ Clariva PN; 2 fl oz/cwt	1654 *b*	49.40 *ab*	64805 *ab*	93730 *a*	55.25 *ab*
S12H2	Illevo; 1.18 fl oz/140000 seeds	2225 *b*	50.66 *a*	63171 *b*	85771 *a*	55.50 *a*

[†]Means followed by the same letter are not significantly different, α=0.05.

3.0 Soybean Cyst Nematode Demonstration II

SERF & Hurley

Similar to SCN Demonstration I, this study also evaluated the efficacy of two experimental products in controlling SCN on two cultivars, H16-R6 and H20-R3. At SERF, the two products were not significantly different in terms of fall SCN numbers, test weight and yield for both cultivars. No differences were observed in stand counts for H16-R6. However, significant differences were observed in stand counts for H20-R3 where Experimental A had lower stand counts (Table 3.1).

No statistical differences were observed in SCN fall numbers, stand counts and test weight at Hurley in both cultivars. However, yield differences were observed for both cultivars. H16-R6 and H20-R3 produced lower yields where Experimental A was used.

Table 3.1. 2016 Soybean Cysts Nematode (SCN) Demonstration II: Fall SCN numbers, yield, early and final stand counts and test weight associated with various seed treatments at Southeast Farm near Beresford, SD.

Cultivar	Treatment	Fall SCN numbers	Yield (lb/A)	Early Stand Count (plants/A)	Final Stand Count (plants/A)	Test Weight (lb/bu)
H16R6	Experimental A	1308 *a*†	51.28 *a*	129645 *ab*	120558 *ab*	56.73 *a*
H16R6	Experimental B	1083 *a*	49.86 *a*	131969 *ab*	119769 *ab*	56.29 *a*
H20R3	Experimental A	1658 *a*	49.20 *a*	108464 *b*	110293 *b*	56.49 *a*
H20R3	Experimental B	1142 *a*	54.08 *a*	136347 *a*	122398 *a*	56.63 *a*

†Means followed by the same letter are not significantly different, α=0.05

Table 3.2 2016 Soybean Cysts Nematode (SCN) Demonstration II: Fall SCN numbers, yield, early and final stand counts and test weight associated with various seed treatments at Hurley, SD.

Cultivar	Treatment	Fall SCN numbers	Yield (lb/A)	Early stand count (plants/A)	Final stand count (plants/A)	Test weight (lb/bu)
H16R6	Experimental A	1650 *a*	50.26 *c*	94938 *a*	88766 *a*	54.97 *a*
H16R6	Experimental B	1533 *a*	52.16 *bc*	89493 *a*	87875 *a*	55.28 *a*
H20R3	Experimental A	2492 *a*	54.99 *ab*	88514 *a*	82338 *a*	55.01 *a*
H20R3	Experimental B	1792 *a*	57.29 *a*	89855 *a*	84591 *a*	55.21 *a*

†Means followed by the same letter are not significantly different, α=0.05

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Low-Level Auxin Herbicide Applications to Soybeans

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The auxin herbicide study was performed in a tilled field. Soybeans were planted on June 13, 2016 at a population of 160,000 seeds ac^{-1} using the soybean variety, P20T79R2. The trial was a randomized complete block design with four replications. Each main plot had four rows that were 10 ft. wide and 125 ft. long. Clarity® (i.e. dicamba, BASF Corporation). The first application was made at V1 soybean growth stage at 0.00089lbs ae ac^{-1} of dicamba. Visual responses were present and easily noticeable at these rates. Applications were also applied at V3, V1+V3, V5, and at V3+V5. Spraying was performed with a 4-nozzle CO_2 backpack sprayer at approximately 12 gal. ac^{-1}. A non-ionic surfactant was added at 0.5% (v/v).

After the completion of herbicide treatments, all main plots were split into five 25 ft. subplots, two foliar and soil N treatments and one untreated. Foliar and soil N was applied 5-7 days and 10-15 days after the latest dicamba application of each main plot. All N treatments contained 42 lbs. of N using a foliar 28% fertilizer or a 50% blend of ESN and urea with a N stabilizer.

At R2, samples were taken for nodulation counts and biomass from each plot. Chlorophyll readings were also taken at this time. At harvest, the two middle rows of each plot were taken for yield, protein, moisture, and oil.

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SDSU Biophysics and Hydrology Lab: Project Report from Southeast Research Farm Plots

Sandeep Kumar (PI)*, Abdullah Alhameid, Liming Lai, Ekrem Ozlu, Colin Tobin, Peter Sexton, Anthony Bly, and Sara Berg

Project 1 (Long-term Rotation Plots/ Field 302)

Title. Tillage and Crop Rotation Impacts on Soil Properties.

Project personnel: Sandeep Kumar (PI), Abdullah Alhameid (PhD candidate)

Summary. The experimental site is located at the Southeast Research Farm of the South Dakota State University located at Beresford, South Dakota. The experiment was initiated in 1990 to assess the impact of different tillage systems and crop rotations on the long term production and economics of cropping systems. The experimental site has 80 plots distributed randomly in a complete block design. Each plot has a width of 20 m and a length of 100 m. The experimental plots were designed to be large so that field operations could be carried out using commercial sized farm equipment. The experiment had three different tillage systems which were no till (NT), conventional till (CT), and ridge till (RT). Ridge till system had only a two-year crop rotation of corn (*Zea mays* L.) – soybean (*Glycine max*. L.). In the fall of every year after harvest, residues of corn, soybean, and wheat were disked and chiseled in all of the conventionally tilled plots. The RT plots were excluded from this study because it had only one rotation system. Both NT and CT had three rotation systems, which were a two-year rotation of corn-soybean, a three-year rotation of corn-soybean-wheat (*Triticum aestivum* L.), and a four-year rotation of corn-soybean-wheat-oat (*Avena sativa*).

Task 1. Measurement of Soil Organic Matter (SOM) and nutrients. Soil samples were collected every fall after harvesting the crops from 1991 to 2004 from each plot. Three cores of soil samples from each plot were collected at a depth of 0-15 cm using a 3.5-cm diameter and 50-cm-tall hand probe (Inc. JMC Soil Samplers) and mixed together to make a composite sample. Composited soil samples were labeled, sealed in plastic zip-lock bags, and transported to the laboratory. Every year, after bringing the soil samples to the laboratory, all of them were air dried, ground, and sieved to pass a 2-mm sieve. All of the analyses were carried out using the soil fine fraction (< 2 mm in diameter). Soil organic matter (SOM) was measured using the loss on ignition (LOI) method (Mikha et al., 2006). Briefly, 10 g of each soil sample was weighed in an aluminum crucible, transferred to a muffle at a temperature of 450-500 ^{o}C for 4 h, and then the loss of weight was determined. P was extracted using a 0.5 *M* $NaHCO_3$ solution and then the extraction was measured calorimetrically (Olsen, 1954). Nitrate was determined using a nitrate-specific ion electrode. Available K was extracted by 1 M NH_4OAc at pH 7.0, and it was determined using an atomic absorption (AA) (Warncke and Brown, 1998)

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Task 2. *Measuring Soil Quality Parameters*. The impact of long-term soil management and crop rotation systems on selected soil properties. (TN, TC, SIC, pH, EC, C fractions, Soil aggregate, soil penetration resistance, bulk density). (Chapter #1 of PhD dissertation, Alhameid).

Task 3. *Measuring Hydrological Properties*. Influence of long-term soil management and crop rotation systems on hydrological and physical properties. (Water infiltration, field capacity, soil penetration resistance, soil textural analysis, bulk density, soil water retention, and pore size distribution). (Chapter #2 of PhD dissertation, Alhameid).

Task 4. *Measurements of Soil Microbiological Parameters.* The impact of crop rotations systems and tillage managements on soil microbial community. (Chapter #3 of PhD dissertation, Alhameid).

Task 5. *Response of Diversified Cropping Systems to Soil Quality Parameters.* This will address the general premise of the crop rotations, intensification impacts on soil physical and biological functions and how conservation systems minimize such effects. Intensified agroecosystems (long-term diverse crop rotations, cover crops and their impacts on soil organic carbon and health indicators). Study will assess the impacts of crop rotation on soil organic carbon and C Fractions Rotation impacts on selected soil quality parameters (Dr. Maiga)

Project 2. (Manure Plots/ Field 103)

Title. Response of manure and inorganic fertilizer applications on soil properties.

Project personnel: Sandeep Kumar (PI), Ekrem Ozlu (PhD student)

Summary. The experimental site for SDSU soil fertility project is located at the Southeast Research Farm of the South Dakota State University located at Beresford, South Dakota. The experiment was established in 2003 to assess the influences of beef manure and inorganic fertilizer on the long term corn (*Zea mays* L.) – soybean (*Glycine max*. L.) rotation. The experimental site has 24 plots with 4.6 to 20 m dimensions into complete randomized block design. Study treatments included: three manure (dairy and beef manure) [P-based recommended manure application rate (P), N-based recommended manure application rate (N), nitrogen-based double of recommended manure application rate (2N)], two fertilizers [recommended fertilizer (F) and high fertilizer (HF)], and a control (CK) with no manure application]. The manure was applied in the spring in a manual application and incorporated by disk at 6-cm deep for 1 to 3 days before planting at either site. Manure of the study was analyzed by South Dakota Agricultural Laboratories. Fertilizer treatments for 179.3 kg ha-1 yield goal for corn and 44.8 kg ha-1 for soybean were used for both the sites; however, no nutrient recommendation of fertilizer for soybean was used.

Task 1. *Measurement of Soil quality indicators.* Soil samples were extracted from 0-10, 10-20, 20-30 and 30-40 cm depths in 4 replicates and mixed together to make a composite sample for each plot in 2015 to analyze selected soil quality indicators. Composited soil samples were labeled, sealed in plastic zip-lock bags, and transported to the laboratory. Every year, after bringing the soil samples to the laboratory, all of them were air dried, ground, and sieved to pass a 2-mm sieve. Wet aggregate stability of the soil for the 0-10 and 10-20 cm depths was measured using the procedure of Kemper and Rosenau (1986). The pH of the soil is a measure of the concentration of the hydrogen ion (H+) concentrations. Soil pH was determined using a suspension sample with soil (air-dried) to the water (soil: water) ratio of 1:1 procedure, and measured with an Orion star pH and EC meter. Electrical conductivity (EC) was measured with 1:2 of soil: water ratio using electronic pH and EC meter. The method outlined by Stetson, Osborne, et al. (2012) was used to determine carbon (C) and nitrogen (N) concentrations after removing visible crop residues and sieved through a 0.5 mm. Total C (TC) and nitrogen (TN) were analyzed by combustion using a Tru-Spec-CHN analyzer (LECO Corporation, St. Joseph, MI). Soil inorganic carbon (SIC) was measured using 1M 10 ml of HCI addition to the one gram of the 0.5 mm sieved soil samples. The loss of the weight from the initial weight of the total was given as SIC. Soil organic carbon (SOC) was calculated by subtracting SIC from TC and expressed in g kg-1. (Chapter #3 of Ms. Thesis, Ozlu, E.)

Task 2. _Measuring Soil Hydrological Properties_. The impact of long-term manure and inorganic fertilizer application on selected soil physical and hydrological properties. (Bulk Density, soil penetration resistance, soil water retention, pore size distribution, water infiltration). (Chapter #4 of Ms. Thesis, Ozlu, E.)

Task 3. _Measurements of Soil Nutrients and crop yield._ The impact of manure and inorganic fertilizer applications on soil nutrients and crop yield. Soil samples at depths of 0 to 15 cm and 15 to 60 cm, were taken at the beginning of the experiment before manure application and mineral fertilization year by using push prop truck and soil data were used to calculate amount of manure rates. On the other hand, soil samples from 2003 to 2015, were collected in the fall after harvesting of the crop from both long-term sites and year by using push prop truck from 0 to 15 cm and 15 to 60 cm soil depth. Disturbed soil samples were extorted from three replications of each plot from 0 to 15 cm and 15 to 60 cm depths and mixed together to make a composite sample for the respective depth. Soil samples were carried in plastic zip-lock bags, labeled, transported to the lab, and stored for analysis. Soil was air dried, mechanically grinded, and sieved through 2-mm sieve to analyze and also stored at 4 °C. The long-term plots were next to each other for each site, and hence, had similar soil and slope characteristics. Soil analysis was performed to determine N, P, K, Soil organic matter (SOM), Sulfur, Zinc, pH, Salts and Texture. The pH of the soil is a measure of the concentration of the hydrogen ion H+. The most favorable pH range is generally considered to lie between 6.0 and 7.5. If the pH is above 8.5, and alkali condition is often indicated. Soil pH was determined through a suspension sample with a soil (air-dried) to water (soil: water) ratio of 1:1 procedure and measured with a pH meter. Available phosphorus in soil was determined by extracting samples with 0.5 M NaHCO3, and determining using Olsen method (Olsen et al., 1954). Total N in soil was determined by Kjeldahl digestion–distillation method (Bremner and Mulvaney, 1982). Available potassium is displaced from exchange sites by 1N (pH 7.0) NH4OAc and the concentration of K measured by flame emission on the A.A. spectrophotometer. This procedure is designed to determine soluble sulfate-sulfur plus a fraction of the absorbed sulfate. The phosphate ions displace the adsorbed sulfate and the calcium ions depress the extraction of soil organic matter; thus reducing contamination from extractable organic sulfur. The basis for the use of DTPA extraction is the amount of Zn extracted from the soil during the specified extraction time by the chelating agent. The pH of 7.3 and 0.01 M CaCl2 will minimize the dissolution of CaCO3 from calcareous soils. Soluble salts are most commonly detected by measuring the soil solution's ability to conduct an electrical current, referred to as electrical conductivity (EC). The higher the conductivity (measured in mmhos/cm), the higher the salt content of the soil. Once a salt problem is identified with this procedure, a more detailed analysis is done. Saturation extract method was used. The indicator of a problem is a conductivity 2.5 mmhos/cm or above with the 1:1 soil to water method. Hydrometer method was used to determine soil particular distribution (Texture).Soil organic matter (SOM) was determined by using loss on ignition method (Davies 1974).

Project 3. Helena Project (corn with fertilizer treatments/Beresford site)

Title. Evaluating the impacts of humic acid applied with nitrogen fertilizer on corn growth and soil quality in South Dakota.

Project personnel: Sandeep Kumar (PI), Liming Lai (PhD candidate)

Summary. The integration of inorganic fertilizers with Humic Acid (HA) is an effective way to keep high crop yields and maintain soil health. However, little is known about the evaluation of HA applied with nitrogen (N) fertilizer on both corn (*Zea mays*

L.) growth and soil properties in South Dakota, USA. The objectives were to evaluate the impacts of HA applied with N fertilizer on corn yield, corn stem height and diameter, and the selected soil properties. The experiment was a split-plot in randomized complete block (RCBD) design with 4 replications at the SDSU Southeast Research Farm, South Dakota from 2013 to 2015. The six fertilizer treatments were established in 2013 for evaluating corn yield only. Another 12 fertilizer treatments were established in 2014 and 2015 for assessing corn growth and soils. The results from this study show that the HA applied with N fertilizer significantly influenced corn yield and stem diameter and height. It did not significantly impact wet aggregate stability (WAS), carbon to nitrogen (C: N) ratio, and bulk density (ρ_b). It, however, significantly impacted the soil pH, electrical conductivity (EC), soil organic matter (SOM), soil organic N (SON), and water soluble ammonia (NH_3) in soils. The findings from this study suggest that the appropriate fertilization of HA applied with N fertilizer can both increase corn yield and reduce the cost of fertilizer application and improve soil quality to some extent. Our recommendation is for the application of UAN preplant 85% + HA in corn fields because it is the best way to not only increase corn yield and reduce the cost of N fertilizer application but also improve soil quality among the four ways of application of HA applied with N fertilizer in this study.

Task 1. *Measuring Soil Bulk Densit (ρ_b), pH, Electrical Conductivity (EC), and Wet Aggregate Stability (WAS)*

Soil samples were collected from each plot within one week after harvesting in 2014 and 2015 for measuring the selected soil properties at the 0- to 10-cm, 10- to 20-cm, 20- to 40-cm depths. The three samples were taken randomly from each plot. The field-moist samples were first used for the measurement of soil ρ_b, which was determined by the core method (Grossman and Reinsch, 2002). The remaining soil samples were air-dried. Soil pH and EC were measured using Orion star pH and EC meter using 1:1 soil: water ratio and 1: 2.5 soil: water ratio, respectively. The WAS were measured using the wet sieving method (Kemper and Rosenau, 1986; Yoder, 1936) for 1-2 mm sized fraction of soil aggregate samples. The data in 2014 and 15 were measured.

Soil samples were collected from each plot within one week after harvesting in 2016 for measuring the selected soil properties at the 0- to 10-cm depth. The data in 2016 are being measured.

Task 2. *Measuring Soil Organic Matter (SOM), Soil Organic Nitrogen (SON), Water Soluble Ammonia (NH_3), Carbon to Nitrogen Ratio (C: N ratio)* SOM, SON, NH_3, and C: N ratio were measured by the Midwest Laboratories (Midwest Laboratories Inc., Omaha, NE). The SOM was determined using the method of Loss of Weight on Ignition (NCR). Water Soluble Total Nitrogen and Water Soluble Carbon were measured using a Teledyne Tekmar TOC Torch, which is a combustion analyzer that uses chemiluminescence for the detection of Nitrogen and Nondispersive infrared (NDIR) for the detection of Carbon. The Ammoniacal-N was determined with a Westco Smart Chem instrument that is a discrete auto-analyzer that uses a colorimetric method for the determination of Ammoniacal-N. The Nitrate-N was analyzed by a cadmium reduction flow analyzer. The Organic N was calculated by subtracting the Nitrate-N and Ammoniacal-N from the Total N. The C: N ratio was computed by dividing the Organic Carbon by the Organic N. The data in 2014 and 15 were measured.

The data in 2016 are being measured.

Task 3. *Measuring Corn Stem Height and Diameter and Corn Yields*

Corn stem height and diameter were measured at two weeks before harvesting in 2014, 2015, and 2016. Corn height was obtained from three randomly chosen plants with the highest stalk within each plot. Corn height was measured from the soil surface to the highest point of the uppermost free standing corn leaf. Corn diameter was gained from three randomly chosen plants with the thickest stem in each plot and measured with calipers.

Corn yields in 2013, 2014, 2015, and 2016 were measured. Corn was harvested with Kincaid Plot Combine. The combine harvest system collected moisture (%), plot weight (lbs.), and test weight (lb bu^{-1}). These data were used to calculate yield for each individual plot harvested. Corn yield (bu ac^{-1}) was expressed at 15% moisture.

Project 4. (Grazing Cover Crops/Beresford site)

Title. Demonstrating Short-Term Impacts of Grazing Cover Crops on Soil Health in South Dakota.

Project personnel: Sandeep Kumar (PI), Colin Tobin (Master student)

Summary. Grasslands have been rapidly converted to croplands over the last decade in the northern Great Plains. This conversion has the potential to reduce soil health and increase the region's ability to pollute the Missouri and Mississippi rivers. Therefore, the need for integrated crop livestock (ICL) practices that protect the region's native prairies are strongly encouraged. Introducing livestock into arable cropping systems can improve nutrient cycling, soil health, and provide economic benefits. The present study was conducted under a corn (*Zea mays* L.)-soybean (*Glycine max* L.)-rye (*Secale cereale* L.) rotation with no-till system at the Southeast Research Farm near Beresford, South Dakota to assess the effects of ICL systems on selected soil health parameters. Cover crops blends (Brassica/Legume-based blend, Grass-based blend, Equal blend) were planted after the rye (*Secale cereale* L.) crop, and grazing treatments (with and without) were applied after the cover crops establishment. Cover crops were grazed from November 2 through November 12, 2015. Concerns regarding the role of hoof traffic from livestock adversely affecting the near-surface soil conditions, soil health, and hydrological properties under no-till systems will be discussed. Data showed that the use of diverse cover crop mixtures provided increased biomass on the surface that can alleviate the compaction impact under these integrated crop-livestock systems. Surface bulk density was not significantly impacted by grazing but deeper than 5cm was. Some soil physical and hydrological properties were significantly affected due to the high moisture content of the soil during the grazing period. Carbon fraction data was studied to find the impact of short-term grazing on the microbial biomass, labile and stable carbon fractions from 0-5 cm and 5-10 cm depths. Grazing had no effect on beta-glucosidase enzyme activity or microbial biomass carbon. This study provides useful information about short-term (one-year) grazing impacts on soil surface physical, hydrological, and biological properties in southeastern South Dakota.

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Evaluating the Effect of NPK Fertilizer on the Interaction between Soybean Cyst Nematode and Fusarium spp. in Beresford, SD, 2016

Mathew*, F., Okello P., Osborne, S,. Kontz B., Kirby, K., and Kleinjan, J.

A field trial was conducted at the South Dakota State University Southeast Research Farm in Beresford, SD in 2016. Soybean seeds of two soybean varieties (Monsanto, St. Louis, MO) - 'AG2531 (RM 2.4)' (Susceptible to SCN) and 'AG2336 (RM 2.3)' (resistance to SCN) – were planted on 20 May 2016 into a conventional-till field of silty clay loam soil previously cropped to oats. Before planting, the following herbicides were applied on May 1, 2016:- 32 oz/A Roundup, 1.3 pt/A Dual, 4 oz/A Sencor, and 1 oz/A Sharpen. The experimental design was a randomized complete block with 4 replicate blocks. The experimental plots were planted as 4 rows, spaced 30 in. apart and 20 ft long with a four-row SRES Precision Planter at a rate of 165,000 seed/A. For inoculum, *Fusarium proliferatum* and *Fusarium virguliforme* was grown for three weeks on autoclaved millet and sorghum seeds respectively in trays at 22°C. After incubation, the colonized millet and sorghum seeds were air dried and stored at 25°C until use. The colonized seeds were spread on the plots using a fertilizer cart approximately seven days after planting to coincide with rain. Fertilizers were spread with a fertilizer cart at the rate of 15: 15: 15 (N: P: K) for starter fertilizer treatment and 50: 80: 110 (N: P: K) for high levels of fertilizer treatment.

Stand counts were taken on 14 days after planting (June 2) and 28 days after planting (June 16) when the soybean were in the vegetative stage V2 (second trifoliate) and V4 (fourth trifoliate) as the total number of plants in the middle two rows of each plot. Additionally, soil was sampled from each of the plots to get an initial assessment of SCN and every 35 days until harvest. Plants in each plot were examined for symptoms of damping-off when stand counts were taken. Phytotoxicity, and vigor was evaluated on June 2 using the following scale, where: 0 = 0%, 2 = trace to 4%, 7 = 5 to 10 %, 15 = 11 to 20%, 30 = 21 to 40%, 50 = 41 to 60%, 70 = 61- 80%, 85 = 81 to 90%, 93 = 91 to 95%, and 98 = 96 to 100%. At the time of stand counts and every 35 days, ten soybean plants were sampled from the outer two rows of each plot to rate for root rot severity. After planting, the following herbicides were applied on July 1, 2016; 12 oz/a Flexstar, 0.3 oz/a First Rate, 8 oz/a Select, 4 oz/a Latch to soybean. On August 17 (R4 growth stage) and September 1 (R5-R6), the plots were examined for foliar symptoms of SDS. However, SDS was not observed. On 20 October, soil was sampled from each of the plots to get a final SCN count. On 24 October, the middle two rows of all plots were harvested.

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Data was analyzed using R (v2.11.1; https://www.rstudio.com/). Treatment means were separated using LSD test ($P \leq 0.05$).

Plant stands taken at 14 days after planting (DAP) and 21 days after planting (DAP) were not significantly different ($P >$ 0.05) among treatments. However numerical differences were observed between either of the two N-P-K fertilizer applications and none fertilizer application in both *F. proliferatum* (Table 1) and *F. virguliforme* (Table 2) inoculated plots with both SCN susceptible and resistant soybean varieties. At vegetative stage VE-V1 (emergence and first trifoliate) and reproductive stage R4-R5 (pod development stage), disease severity was not significantly different ($P > 0.05$) in both SCN-susceptible and resistant cultivars plots. However, disease was higher at reproductive stage compare to the vegetative stage with no observed effect of either of the two fertilizer applications.

The initial SCN population densities (per 100cc of soil) ranged from 575 to 950 eggs and juveniles/100cc of soil in *F. proliferatum* inoculated plots, 325 to 825 eggs and juveniles/100cc of soil in plots inoculated with *F. virguliforme* and 325 to 1175 eggs and juveniles /100cc of soil in non-inoculated plots. At harvest, higher SCN population densities (>9000/100cc of soil) were observed in SCN susceptible plots compared to plots with SCN resistant soybean varieties.

Yield (bu/A) was significantly different ($P < 0.05$) among treatments. For *F. proliferatum* and *F. virguliforme,* highest yields were observed in plots with SCN resistant soybean cultivars in combination with starter fertilizer treatment (Table 1 and Table 2). This trial will be repeated in 2017.

In May, the temperatures were in the range 45-69°F and monthly rainfall total was 3.23 inches. In June, the temperatures were in the range 55- 78°F and monthly rainfall total was 3.39 inches. In July, the temperatures were in the range 60- 84°F and monthly rainfall total was 3.58 inches. In August, the temperatures were in the range 57- 82°F and monthly rainfall total was 2.64 inches. In September, the temperatures were in the range 46- 72°F and monthly rainfall total was 2.4 inches.

ACKNOWLEDGEMENT

Project funded by the South Dakota Soybean Research and Promotion Council.

Table 1. Analysis of Variance (ANOVA) to evaluate the effect of NPK fertilizer on the interaction between soybean cyst nematode and *Fusarium proliferatum* in Beresford, SD, 2016.

Variety	Pathogen	Fertilizer treatments	Stand Count (14 DAP)	Stand Count (28 DAP)	Disease Severity (VE-V1)	Disease Severity (R4-R5)	SCN count (Initial)	SCN Count (Final)	Yield (bu/A)
SCN susceptible	F. proliferatum +SCN	N: P: K (0: 0: 0)	118483.2	111731.4	28.3	48.9	625.0	29300.0	36.4
	SCN	N: P: K (0: 0: 0)	108682.2	106939.8	40.1	48.4	325.0	9375.0	34.9
	F. proliferatum +SCN	N: P: K (15: 15: 15)	103455.0	93000.6	31.8	49.2	575.0	26425.0	41.3
	SCN	N: P: K (15: 15: 15)	105633.0	97574.4	32.3	49.5	325.0	10825.0	46.0
	F. proliferatum +SCN	N: P: K (50:80:110)	111513.6	97138.8	24.5	49.4	575.0	29350.0	34.4
	SCN	N: P: K (50:80:110)	75358.8	75141.0	22.5	47.8	500.0	14775.0	46.4
SCN resistant	F. proliferatum +SCN	N: P: K (0: 0: 0)	103890.6	105633.0	30.3	48.8	850.0	2725.0	64.6
	SCN	N: P: K (0: 0: 0)	108682.2	111078.0	34.8	47.5	550.0	1350.0	60.2
	F. proliferatum +SCN	N: P: K (15: 15: 15)	108028.8	102148.2	33.8	45.7	675.0	2775.0	67.1
	SCN	N: P: K (15: 15: 15)	102583.8	86684.4	20.3	45.7	1175.0	2250.0	63.8
	F. proliferatum +SCN	N: P: K (50:80:110)	91911.6	89733.6	29.0	47.4	950.0	2000.0	65.5
	SCN	N: P: K (50:80:110)	80586.0	66864.6	38.9	46.4	425.0	2675.0	53.4
LSD @ 0.05			37352.7	30348.0	12.3	10.7	748.2	23802.8	28.7
P-value			0.435	0.123	0.080	0.998	0.421	0.108	0.144

Table 2. Analysis of Variance (ANOVA) to evaluate the effect of NPK fertilizer on the interaction between soybean cyst nematode and *Fusarium virguliforme* in Beresford, SD, 2016.

Variety	Pathogen	Fertilizer treatments	Stand Count (14 DAP)	Stand Count (28 DAP)	Disease Severity (VE-V1)	Disease Severity (R4-R5)	SCN count (Initial)	SCN Count (Final)	Yield (bu/A)
SCN susceptible	F. virguliforme +SCN	N: P: K (0: 0: 0)	62944.2	67953.6	29.5	45.7	425.0	10350.0	37.5
	SCN	N: P: K (0: 0: 0)	108682.2	106939.8	40.1	48.4	325.0	9375.0	34.9
	F. virguliforme +SCN	N: P: K (15: 15: 15)	77754.6	75358.8	34.5	47.7	425.0	10975.0	43.6
	SCN	N: P: K (15: 15: 15)	105633.0	97574.4	32.3	49.5	325.0	10825.0	46.0
	F. virguliforme +SCN	N: P: K (50:80:110)	107593.2	100405.8	32.3	45.6	325.0	44125.0	47.0
	SCN	N: P: K (50:80:110)	75358.8	75141.0	22.5	47.8	500.0	14775.0	46.4
SCN resistant	F. virguliforme +SCN	N: P: K (0: 0: 0)	109771.2	101712.6	37.8	49.1	600.0	1850.0	63.9
	SCN	N: P: K (0: 0: 0)	108682.2	111078.0	34.8	47.5	550.0	1350.0	60.2
	F. virguliforme +SCN	N: P: K (15: 15: 15)	93218.4	84070.8	35.0	47.4	825.0	2125.0	70.6
	SCN	N: P: K (15: 15: 15)	102583.8	86684.4	20.3	45.7	1175.0	2250.0	63.8
	F. virguliforme +SCN	N: P: K (50:80:110)	100623.6	97574.4	34.3	44.8	500.0	1975.0	52.9
	SCN	N: P: K (50:80:110)	80586.0	66864.6	38.9	46.4	425.0	2675.0	53.4
LSD @ 0.05			49456.8	39122.9	13.7	8.8	516.8	21149.9	23.5
P-value			0.488	0.263	0.151	0.981	0.100	0.035	0.104

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Evaluating an Integrated Approach to Manage Interaction between Soybean CystN (SCN) and Sudden Death Syndrome (SDS; *Fusarium virguliforme*) in Beresford, SD, 2016.

Mathew*, F., Braun, N., Okello, P., Adhikari A., Kontz, B., Kirby, K., and Kleinjan J.

A field trial was conducted at the South Dakota State University Southeast Research Farm in Beresford, SD in 2016. Soybean seeds of three conventional soybean varieties (DuPont Pioneer) - 92M10 (Susceptible to SCN and SDS), P16TO4R (susceptible to SCN and tolerant to SDS), and P19T60R (resistance to SCN and tolerance to SDS) - were planted on 20 May 2016 into a conventional-till field of silty clay loam soil previously cropped to oats. Before planting, the following herbicides were applied on May 1, 2016:- 32 oz/A Roundup, 1.3 pt/A Dual, 4 oz/A Sencor, and 1 oz/A Sharpen. The experimental design was a randomized complete block with 4 replicate blocks. The experimental plots were planted as 4 rows, spaced 30 in. apart and 20 ft long with a four-row SRES Precision Planter at a rate of 165,000 seed/A. For inoculum, *Fusarium virguliforme* was grown for three weeks on autoclaved sorghum seeds in trays at 22^{o}C. After incubation, the colonized sorghum seeds were air dried and stored at 25^{o}C until use. The colonized sorghum seeds were spread on the plots using a fertilizer cart approximately seven days after planting to coincide with rain. Stand counts were taken on 14 days after planting (June 2) and 28 days after planting (June 16) when the soybean were in the vegetative stage V2 (second trifoliate) and V4 (fourth trifoliate) as the total number of plants in the middle two rows of each plot. Additionally, soil was sampled from each of the plots to get an initial assessment of SCN. Plants in each plot were examined for symptoms of damping-off when stand counts were taken. Phytotoxicity, and vigor was evaluated on June 2 using the following scale, where: 0 = 0%, 2 = trace to 4%, 7 = 5 to 10 %, 15 = 11 to 20%, 30 = 21 to 40%, 50 = 41 to 60%, 70 = 61- 80%, 85 = 81 to 90%, 93 = 91 to 95%, and 98 = 96 to 100%. At the time of stand counts, ten soybean plants were sampled from the outer two rows of each plot to rate for root rot severity. After plant, the following herbicides were applied on July 1, 2016; 12 oz/a Flexstar, 0.3 oz/a First Rate, 8 oz/a Select, 4 oz/a Latch to soybean. On August 17 (R4 growth stage) and September 1 (R5-R6), the plots were examined for foliar symptoms of SDS. However, SDS was not observed. On 20 October, soil was sampled from each of the plots to get a final SCN count. On 24 October, the middle two rows of all plots was harvested. Data was analyzed using R (v2.11.1; https://www.rstudio.com/). Treatment means were separated using LSD test ($P \leq 0.05$).

Vigor was at 100% for all treatments, with no differences among treatments and was

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not included in the data analyses. Phytotoxocity was observed only on those treatments treated with seed treatment (ILeVo, Bayer CropScience, Research Triangle Park, NC). Plant stands taken at 14 days after planting (DAP) and 21 days after planting (DAP) were not significantly different (*P* > 0.05) among treatments. However numerical differences were observed (at least 5% higher) between untreated check and treatments containing ILeVo or resistant soybean varieties at 14 days after planting (DAP). No pre-emergence damping-off occurred in this study. Brown to reddish discoloration by root rot pathogens was visible on the cortical layer of the main root and hypocotyl; however, disease severity was not significant (*P* > 0.05) among treatments. Test weight and moisture content was not significantly different (*P* > 0.05) among treatments. **Yield (bu/A) was significantly different (*P* < 0.05) among treatments. For example, by combining resistance to the two pathogens with ILeVO seed treatment, a yield increase of 13 bu/A was observed (Table 1). This trial will be repeated in 2017.**

In May, the temperatures were in the range 45-69^{o}F and monthly rainfall total was 3.23 inches. In June, the temperatures were in the range 55- 78^{o}F and monthly rainfall total was 3.39 inches. In July, the temperatures were in the range 60- 84^{o}F and monthly rainfall total was 3.58 inches. In August, the temperatures were in the range 57- 82^{o}F and monthly rainfall total was 2.64 inches. In September, the temperatures were in the range 46- 72^{o}F and monthly rainfall total was 2.4 inches.

ACKNOWLEDGEMENT

In collaboration with DuPont Pioneer and Bayer CropScience. Funded by the South Dakota Soybean Research and Promotion Council.

Table 1. Analysis of variance (ANOVA) to manage interaction between soybean cyst nematode (SCN) and sudden death syndrome (SDS; *Fusarium virguliforme*) using seed treatments and host genetics (in collaboration with DuPont Pioneer and Bayer CropScience).

S. No	Variety	Genes	Treatment	Stand Count (14 DAP)	Stand Count (28 DAP)	Disease Severity (14 DAP)	Disease Severity (28 DAP)	SCN count (Initial)	SCN Count (Final)	Yield (bu/A)
1	92M10	SCN/SDS Susceptible	None	96158.7 a	84743 a	16.25 a	16.25 a	205.625 a	325 a	33.39 cd
2	92M20	SCN/SDS Susceptible	ILeVO	94307.4 a	87337.8 a	15 a	15 a	126.875 ab	281.25 a	26.68 d
3	P16TO4R	SDS Tolerant	None	110642.4 a	84634.1 a	12.5 a	16.25 a	18.625 c	493.75 a	56.82 a
4	P16TO4R	SDS Tolerant	ILeVO	97683.3 a	80259.3 a	12.5 a	20 a	21.250 c	225 a	48.54 ab
5	P19T60R	SCN/SDS Resistant/tolerant	None	95723.1 a	88426.8 a	15 a	18.75 a	46.625 bc	331 a	43.75 bc
6	P19T60R	SCN/SDS Resistant/tolerant	ILeVO	109880.1 a	103781.7 a	16.25 a	18.75 a	11.000 c	293.75 a	47.34 d
CV				17.55	27.48	42.38	27.77	108.62	7.75	21.85
LSD @ .10				21679.54	30845.14	7.58	5.96	95.45	309.84	11.46
LDS @ .05				26266.54	37370.73	9.18	7.22	115.65	375.40	13.88

SOUTHEAST RESEARCH FARM ANNUAL REPORT
South Dakota State University
2016 Progress Report
Agricultural Experiment Station
Plant Science Department
South Dakota State University, Brookings, SD 57007
Southeast Research Farm, Beresford SD 57004

SDSU Oat Breeding

Melanie Caffe-Treml* and Nick Hall

In 2016, South Dakota ranked first for oat production with 9 million bushels. Oat is a low input crop which can break pest cycles and improve soil health in corn-soybean rotations. In South Dakota, oat is grown mainly for forage and grain production. The goal of the oat breeding program at SDSU is to develop new oat varieties that have increased productivity and improved end-use quality for both forage and grain production in order to increase the profitability of South Dakota producers.

The SDSU oat breeding program uses the Southeast Farm as one of its multiple testing locations in the state to ensure that new varieties developed by the breeding program are adapted to the broad range of environmental conditions encountered in the state. In 2016, over one thousand test plots were seeded at SERF. Our nine most advanced breeding lines were evaluated in the South Dakota Crop Performance Testing. Two experimental breeding lines performed well and have the potential to be released in the two coming years:

- Experimental line SD120296 is an F_5-derived breeding line with the pedigree Saber/SD060130. It is an early maturing variety heading approximately one day earlier than Shelby 427. Plant height of SD120296 is similar to Horsepower and exhibits excellent lodging resistance. Line SD120296 exhibited high yield potential with average test weight when evaluated in the state and regional nurseries. It is resistant to smut, moderately tolerant to BYDV, and resistant to crown rust.

- Experimental line SD120665, evaluated in the 2016 UMOPN (Table1) and in the 2016 SD CPT Oat Variety Trials, demonstrated high yield potential and excellent test weight. It is resistant to smut, moderately tolerant to BYDV, and moderately resistant to crown rust. It is a mid-to-late maturing variety with heading date similar to Hayden. Plant height of SD120665 is approximately 1 to 2 inches taller than Horsepower. Lodging resistance is average. If further evaluation confirms the excellent potential of SD120665, it could be released in Fall 2018.

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Table 1. Performance of South Dakota breeding lines in the 2016 Uniform Mid-Season Oat Performance Nursery (UMOPN) at South Dakota locations.

	SERF		Average§			
	Yield	TW	Yield	TW	HD	Height
Entry	(Bu/Acre)	(lb/Bu)	(Bu/Acre)	(lb/Bu)	(days)	(inches)
SD120419	101.5	33.6	119.6	34.4	166.7	30.5
MNBT1020-1	99.0	31.5	119.1	33.8	165.5	30.5
MNBT1021-1	79.1	28.6	117.4	32.7	165.8	31.3
WIX9528-1	108.5	32.1	116.9	33	167.2	28
WIX10055-8	108.5	29.6	115.4	30.5	170.2	29.8
WIX10045-12	100.9	31.3	113.2	32.8	167.2	29.3
MN11211	103.5	32.2	112.5	33.3	168.8	31
SD120640	108.6	33.2	111.2	34.2	165.8	30.3
MN11231	106.0	28.4	108.8	29.3	170.3	31.5
Leggett	109.8	30.3	107.3	33	170.2	29.5
WIX10045-9	99.5	30.0	107.2	31.1	168.3	30
SD120665	**96.4**	**34.3**	**106.6**	**35.4**	**167.5**	**30**
WIX9878-3	85.4	29.6	104.9	31.5	167.5	31.5
CDC Norseman	99.9	28.5	103.7	29.2	169	31.8
SD120261	105.2	32.7	102.2	33.8	169.2	31.5
IL10-9872	68.4	31.0	102	34.7	164.7	29.3
SD120553	87.2	32.4	101.7	34.2	168	33.8
OT3083	80.6	30.2	101.5	31.8	168.7	31.3
ND121901	101.2	30.6	97.7	32.6	168.3	31.8
ND121730	66.7	29.6	96.2	32.1	170.5	34.3
ND122321	90.0	32.9	94.2	33.9	167.8	32.3
SD120098	103.9	33.5	92.7	34.7	168	31
ND121207	92.3	29.2	89.6	29.7	169.5	32.8
IL09-5508	82.2	34.6	88.9	35	164.7	26.5
IL09-6937	84.5	31.7	84.6	32	168.8	29
OGLE	92.3	29.4	83.3	29.6	165.7	30
CDC Ruffian	77.1	29.6	76.6	29.6	170.8	29.3
Newburg	88.0	29.0	75.8	29.8	168	30.5
ND100046	80.6	28.9	74.9	29.9	169.3	32.3
ND101473	78.6	29.0	74.3	29.9	169.8	30.5
ND111357	62.0	29.6	71.3	30.3	168.7	31.3
OT3063	73.8	30.7	68.9	29.7	171.2	30

CLINTLAND 64	65.2	30.1	65.4	30.8	167.5	31
Gopher	57.1	29.6	54.2	28.6	168	30.5
HA07-02X22-1	54.1	23.2	47.7	.	171.2	24.8
HA08-03X29-1	34.8	22.3	35.9	.	174	25
Mean	78.7	33.4	92.9	32	168.4	30.4
CV	6.1	2	8.3	2.9	0.6	3.8
LSD	10	1.4	8.9	1.1	1.1	1.6

§ Average over three locations (NERF, Volga, and SERF).

Winter crops present several advantages over spring planted crop including reduced soil erosion, improve water use efficiency, and a better ability to compete with weed. In addition, because grain filling occurs at lower temperature for winter crops, an increase in yield potential could be expected for fall-sown oats in comparison to spring-sown oats. Currently, winter oat is grown is the south-eastern part of the US primarily for forage production. Winter oat is less tolerant to low temperature than other winter cereals such as rye, wheat, and barley. However, there is no report of winter oats evaluation in the Northern Great Plains. If a winter oat line was developed through breeding to have sufficient winter hardiness to survive in the Northern Great Plains, it would be valuable to farmers. For the second year, we evaluated in South Dakota winter oat experimental lines and released cultivars from the Southern oat breeding programs. At SERF, the experiment was planted on August 26th 2015 and harvested on July 1st 2016. In average, winter survival ranged from 38.5 to 99.2% depending on the breeding line/cultivar. Although we were able to identify some entries with good winter survival, the winter 2015-2016 was relatively mild. Winter oat lines were again planted in September 2016 to evaluate survival over multiple years.

Table 2. Average survival of winter oats entries evaluated at two locations in South Dakota (SERF and Winner).

Entries	Winter survival (%)
Gerard 224	38.5
Gerard 229	76.4
NC09-4274N	49.7
NC09-4503N	39.8
NC12-3447	39.8
NC12-3578	88.7
NC12-3742	43.3
NC12-3753	45.9
NC12-3872	64.6
NC12-3922	52.3
NC12-3963	78.8
NC13-6584	51.8
Norline	86.7
Rodgers	50.5
SS76-50	82.1
Wintok	99.2
Average	61.7
CV	22.8
LSD	16.3

ACKNOWLEDGEMENTS

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WEED CONTROL DEMONSTRATIONS and EVALUATION TESTS for 2016

Southeast South Dakota Research Center
Paul O. Johnson*, Ext. Weed Science Coordinator; David Vos, SDSU Ag Research Manager, and Jill Alms, SDSU Ag Research Manager

INTRODUCTION

Experiment stations have an important role in the WEED (Weed Evaluation and Extension Demonstration) Project. Plots provide weed control data for the area served by the Southeast South Dakota Research Center. The station is the major site for corn and soybean weed control studies. Tests at the station focus on common waterhemp, velvetleaf, common cocklebur and foxtail.

2016 TESTS

Several studies were established to evaluate new weed control technologies. The demonstration plots centered around programs that would answer questions on the glyphosate resistance issue around the state, especially as it relates to soybean and corn waterhemp management. A wet spring was followed by very dry summer until August. Some of the soybeans did not canopy until late summer.

NOTE:

Data reported in this publication are results from field tests that include product uses, experimental products or experimental rates, combinations or other unlabeled uses for herbicide products. Trade names of products used are listed; there frequently are other brand products available in the market. Users are responsible for applying herbicide according to label directions. Refer to the appropriate weed control fact sheet available from regional extension offices or iGrow.org for herbicide recommendations.

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Studies listed below are summarized in the following tables. Information for each study is included as part of the summary.

1. Corn Herbicide Demonstration
2. Preemergence Herbicides in Corn
3. Armezon Pro with Adjuvants
4. Corn Weed Control with Anthem Maxx
5. Liberty in LL Corn
6. Roundup Ready Soybean Demonstration
7. Liberty Link Soybean Demonstration
8. Dicamba Soybean Demonstration
9. Two Pass Dicamba Programs in No-Till Soybeans
10. Soybean System Comparisons
11. Soybean Weed Control Comparisons-South
12. Panther Pro Preplant & Preemergence
13. Soybean Preemergence Common Waterhemp Control
14. Weed Control in Soybean with Authority & Anthem Maxx
15. Soybean Programs
16. Cobra + Liberty for Waterhemp Control in LL Soybeans
17. Increased Liberty Rates in LL Soybeans
18. Metribuzin Crop Response on High pH Soils
19. Flexstar with Adjuvant Comparisons
20. Huskie in Sorghum
21. Evaluation of Sharpen with Adjuvants
22. Cover Crop Burndown

ACKNOWLEDGEMENTS

We greatly appreciate the cooperation and assistance provided by the station personnel.

Due to the distance from the SDSU campus, assistance with field preparation and daily oversight of the fields is critical to the success of the weed control research. Field equipment and management of the plot areas are important contributions to the project. Regional Extension field specialists and program technicians provide assistance with tours and utilize the data in direct producer programs, publications and news releases. In addition to the Southeast Farm Report, research results will be published in the annual Weed Control Field Test Data Book, SDSU Pest Management Guides and Weed Control Fact Sheets updated annually for major South Dakota commodities, and on the internet at www.iGrow.org.

Program input and partial support for field programs is also acknowledged.

South Dakota Soybean Research and Promotion Council

South Dakota Oilseed Initiative

South Dakota Wheat Commission

South Dakota Corn Utilization Council

Crop Protection Industries

2016
CORN HERBICIDE DEMONSTRATION
Southeast Research Farm

Treatment	Rate/A	Vele 6/14/16	Cowh 6/14/16	Vele 7/15/16	Cowh 7/15/16	Yield bu/A 10/18/16
Check	---	0 d	0 c	0 c	0 b	115 b
Pre & Epost						
Atrazine + Verdict & Armezon Pro + RU Powermax + COC + AMS	1 pt + 10 oz & 16 oz + 22 oz + 1% + 2.5 lb	98 a	98 a	99 a	99 a	188 a
Pre & Post						
Anthem Maxx + Atrazine & RU Powermax + AMS	4 oz + 1 pt & 22 oz + 1.7 lb	98 a	98 a	99 a	99 a	161 a
Keystone NXT & Resicore + Durango DMA + AMS	1.5 qt & 1.25 qt + 1 qt + 2.5%	95 a	98 a	99 a	99 a	150 ab
Surestart II & Durango DMA + AMS	2 pt & 32 oz + 2.5%	98 a	98 a	99 a	99 a	173 a
Resicore & Durango DMA + AMS	2.5 qt & 1 qt + 2.5%	98 a	98 a	99 a	99 a	170 a
Harness & Impact + Aatrex + Destiny HC + AMS	1.75 pt & 0.75 oz + 1 pt + 1% + 2.5%	70 b	96 b	92 b	99 a	153 ab
Acuron & Halex GT + Atrazine + NIS + AMS	1.5 qt & 3.6 pt + 0.5 pt + 0.25% + 1.7 lb	98 a	98 a	99 a	99 a	195 a
Dual II Mag & Callisto Xtra + RU Powermax + COC +AMS	1.33 pt & 24 oz + 32 oz + 1% + 1.7 lb	55 c	96 b	99 a	99 a	179 a
Balance Flexx + Atrazine & Laudis + DiFlexx + Destiny HC + AMS	3.5 oz + 1.5 pt & 3 oz + 8 oz + 0.5% + 1.5 lb	98 a	98 a	99 a	99 a	164 a
Corvus + Atrazine & RU Pmax + Laudis + DiFlexx + Destiny HC + AMS	3.5 oz + 1.5 pt & 32 oz + 3 oz + 8 oz + 0.5% + 3.4 lb	98 a	98 a	99 a	99 a	170 a
Corvus + Atrazine & Liberty + AMS	3.5 oz + 1.5 pt & 22 oz + 3 lb	98 a	98 a	99 a	99 a	153 ab
Balance Flexx + Atrazine & Liberty + AMS	3.5 oz + 1.5 pt & 22 oz + 3 lb	98 a	98 a	99 a	99 a	144 ab
Verdict & Status + RU Powermax + NIS + AMS	15 oz & 5 oz +22 oz +0.25%+2.5 lb	98 a	98 a	99 a	99 a	160 a
Harness & RU Powermax + Atrazine + AMS	1.75 pt & 22 oz + 1 pt + 2.5 lb	72 b	96 b	98 a	99 a	172 a
Breakfree NXT + Atrazine + Instigate & Abundit Extra + AMS	1.75 pt + 1 pt + 5.25 oz & 32 oz + 1.7 lb	98 a	98 a	99 a	99 a	172 a
Epost						
Solstice + Atrazine + RU Powermax + COC + AMS	2.5 oz + 1 pt + 22 oz + 1% + 1.7 lb	--	--	99 a	99 a	173 a
Harness + Impact + Aatrex + Destiny HC + AMS	1.75 pt + 1 oz + 1 pt + 0.25%+2.5%	--	--	99 a	99 a	181 a
Realm Q + Atrazine + Abundit Extra + AMS	4 oz + 1 pt + 32 oz + 1.7 lb	--	--	99 a	99 a	174 a
Armezon Pro + Atrazine + RU Pmax + COC + AMS	18 oz + 1 pt + 22 oz + 1% + 1.7 lb	--	--	99 a	99 a	162 a
Resicore + Atrazine + Durango DMA + AMS	1.25 qt + 1 pt + 1 qt + 2.5%	--	--	99 a	99 a	173 a

Treatment	Rate/A	Vele 6/14/16	Cowh 6/14/16	Vele 7/15/16	Cowh 7/15/16	Yield bu/A 10/18/16
Epost & Post						
RU Powermax + AMS & RU Powermax + AMS	22 oz + 2.5 lb & 22 oz + 2.5 lb	--	--	99 a	99 a	179 a
Liberty + AMS & Liberty + AMS	22 oz + 2.5 lb & 22 oz + 2.5 lb	--	--	99 a	99 a	172 a

RCB: 4 reps
Variety: DKC 46-36 RIB
Planting Date: 5/17/16
Pre: 5/17/16
Epost: 6/15/16 Corn V5, 12-14 in; Vele 1-5 in; Cowh 1-5 in.
Post: 6/23/16 Corn V7-8, 18-26 in; Vele 4-12 in; Cowh 2-10 in.

Soil: Silty Clay; 3.9% OM; 7.0 pH

Precipitation: (inches)
Pre: 1st week 0.68 2nd week 3.14
Epost: 1st week 0.63 2nd week 0.38
Post: 1st week 0.38 2nd week 0.74

Vele=Velvetleaf
Cowh=Common waterhemp

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Moderate to heavy weed pressure. Full season weed control was required to provide the greatest yields. Very wet early then very dry midseason.

2016
PREEMERGENCE HERBICIDES IN CORN
Southeast Research Farm

Treatment	Rate/A	Vele 6/9/16	Vele 7/15/16	Cowh 7/15/16	Yield bu/A 10/18/16
Check	---	0 d	0 f	0 b	112 b
Pre					
Anthem Maxx + Atrazine	4 oz + 1 pt	98 a	89 ab	98 a	149 a
Surestart II	2 pt	99 a	94 a	98 a	152 a
Resicore	2.5 qt	99 a	97 a	97 a	148 a
Acuron	3 qt	99 a	96 a	97 a	143 a
Balance Flexx + Atrazine	3.5 oz + 1.5 pt	99 a	97 a	98 a	153 a
Corvus + Atrazine	3.5 oz + 1.5 pt	99 a	96 a	99 a	159 a
Acuron Flexi	2.25 qt	99 a	97 a	99 a	162 a
Atrazine + Verdict	1 pt + 10 oz	99 a	87 ab	97 a	147 a
Outlook + Atrazine	1 pt + 1.5 pt	95 ab	81 bc	99 a	138 a
Breakfree NXT + Atrazine + Instigate	1.75 pt + 1 pt + 5.25 oz	99 a	93 a	99 a	154 a
Harness	2.2 pt	86 c	30 e	99 a	140 a
Harness Xtra 6L	1.8 pt	97 a	77 c	99 a	153 a
Bicep Lite II Mag	36 oz	94 b	60 d	99 a	151 a

RCB: 4 reps
Variety: DKC 46-36 RIB
Planting Date: 5/17/16
Pre: 5/17/16

Soil: Silty Clay; 3.9% OM; 7.0 pH

Precipitation: (inches)
Pre: 1st week 0.68 2nd week 3.14

Vele=Velvetleaf
Cowh=Common waterhemp

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Moderate velvetleaf and waterhemp weed pressure. All treatments provided good yields given moisture conditions. Full season velvetleaf control varied by treatment.

2016
ARMEZON PRO with ADJUVANTS
Southeast Research Farm

Treatment	Rate/A	Vele 6/24/16	Cowh 6/24/16	Vele 7/12/16	Cowh 7/12/16
Check	---	0 e	0 b	0 e	0 b
Post					
Armezon + Class Act NG	0.5 oz + 2.5%	92 d	99 a	83 d	97 a
Armezon Pro + Class Act NG	14 oz + 2.5%	93 cd	99 a	86 d	98 a
Armezon Pro + Destiny HC + Class Act NG	14 oz + 0.5 pt + 2.5%	94 bc	99 a	88 bcd	98 a
Armezon Pro + Destiny HC + Class Act NG + Interlock	14 oz + 0.5 pt + 2.5% + 4 oz	94 bc	99 a	87 cd	98 a
Armezon Pro + Strikelock + Class Act NG	14 oz + 0.5 pt + 2.5%	94 bc	99 a	88 bcd	98 a
Armezon + Class Act NG	0.7 oz + 2.5%	94 bc	99 a	89 a-d	98 a
Armezon Pro + Class Act NG	20 oz + 2.5%	94 bc	99 a	89 a-d	98 a
Armezon Pro + Destiny HC + Class Act NG	20 oz + 1 pt + 2.5%	95 ab	99 a	92 abc	98 a
Armezon Pro + Destiny HC + Class Act NG + Interlock	20 oz + 1 pt + 2.5% + 4 oz	95 ab	99 a	93 ab	98 a
Armezon Pro + Strikelock + Class Act NG	20 oz + 1 pt + 2.5%	96 a	99 a	94 a	98 a

RCB: 4 reps
Variety: DKC 46-36 RIB
Planting Date: 5/17/16
Post: 6/15/16 Corn V4, 7-12 in; Vele 1-5 in; Cowh 1-5 in.

Precipitation: (inches)
Post: 1st week 0.63 2nd week 0.38

Soil: Silty Clay; 4.0% OM; 7.8 pH

Vele=Velvetleaf
Cowh=Common waterhemp

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Moderate weed pressure. All treatments provided excellent waterhemp control. The higher rates of Armezon Pro were needed to provide excellent velvetleaf control.

2016
CORN WEED CONTROL with ANTHEM MAXX
Southeast Research Farm

Treatment	Rate/A	VCRR 6/9/16		VCRR 7/15/16		Vele 7/15/16		Cowh 7/15/16		Vele 8/22/16		Cowh 8/22/16		Yield bu/A 10/18/16	
Pre & Post															
Anthem Maxx & Solstice + Atrazine + RU Powermax + COC + AMS	4 oz & 2.5 oz + 0.5 qt + 32 oz + 0.5% + 1.7 lb	0	a	0	a	99	a	99	a	99	a	99	a	168	a
Anthem Maxx + Atrazine & Solstice + Atrazine + RU Powermax + COC + AMS	4 oz + 0.75 qt & 2.5 oz + 0.5 qt + 32 oz + 0.5% + 1.7 lb	0	a	0	a	99	a	99	a	99	a	99	a	172	a
Anthem Maxx + Atrazine + Balance Flexx & RU Powermax + AMS	4 oz + 0.75 qt + 2 oz & 32 oz + 1.7 lb	0	a	0	a	99	a	99	a	99	a	99	a	166	a
Pre & Lpost															
Anthem Maxx + Atrazine & RU Pmax + AMS	4 oz + 0.75 qt & 32 oz + 1.7 lb	0	a	0	a	99	a	99	a	99	a	99	a	170	a
Acuron & RU Powermax + AMS	2.5 qt & 32 oz + 1.7 lb	0	a	0	a	99	a	99	a	99	a	99	a	166	a
Corvus + Atrazine & RU Powermax + AMS	5.6 oz + 0.75 qt & 32 oz + 1.7 lb	0	a	0	a	99	a	99	a	99	a	99	a	160	a
Anthem Maxx + Balance Flexx & RU Powermax + AMS	4 oz + 3 oz & 32 oz + 3.4 lb	0	a	0	a	99	a	99	a	99	a	99	a	165	a
Epost															
Halex GT + NIS + AMS	3.6 pt + 0.25% + 1.7 lb	0	a	0	a	99	a	99	a	99	a	99	a	170	a
Solstice + Atrazine + RU Powermax + COC + AMS	3.15 oz + 0.5 qt + 32 oz + 0.5% + 1.7 lb	0	a	0	a	99	a	99	a	99	a	99	a	161	a
Solstice + Anthem Maxx + RU Powermax + COC + AMS	2.5 oz + 2 oz + 32 oz + 0.5% + 1.7 lb	0	a	0	a	99	a	99	a	99	a	99	a	172	a
Solstice + Anthem Maxx + Atrazine + RU Powermax + COC + AMS	2.5 oz + 2 oz + 0.5 qt + 32 oz + 0.5% + 1.7 lb	0	a	0	a	98	a	99	a	99	a	99	a	177	a
Check	---	0	a	0	a	0	b	0	b	0	b	0	b	120	b

RCB: 4 reps
Variety: DKC 46-36 RIB
Planting Date: 5/17/16
Pre: 5/17/16
Epost: 6/15/16 Corn V5, 12-14 in; Vele 1-5 in; Cowh 1-5 in.
Post: 6/16/16 Corn V5, 12-14 in; Vele 1-5 in; Cowh 1-5 in.
Lpost: 6/23/16 Corn V7-8, 18-26 in; Vele 3-5 in; Cowh 2-10 in.

Precipitation: (inches)
Pre: 1st week 0.68 2nd week 3.14
Epost: 1st week 0.63 2nd week 0.38
Post: 1st week 0.63 2nd week 0.38
Lpost: 1st week 0.38 2nd week 0.74

Soil: Silty Clay; 3.9% OM; 7.0 pH

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Vele=Velvetleaf
Cowh=Common waterhemp
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

Comments: Moderate weed pressure. All treatments provided excellent season long weed control. Yields effected by dry conditions in June and July.

2016
LIBERTY in LL CORN
Southeast Research Farm

Treatment	Rate/A	Vele 6/14/16	Cowh 6/14/16	VCRR 6/14/16	Vele 7/15/16	Cowh 7/15/16	Yield-bu/A Dekalb 10/18/16	Yield-bu/A Pioneer 10/18/16
Check	---	0 b	0 b	0 a	0 b	0 b	114 b	97 b
Epost[1]								
Liberty + AMS	22 oz + 1.7 lb	98 a	98 a	0 a	99 a	99 a	164 a	132 a
Liberty + AMS	29 oz + 1.7 lb	98 a	98 a	0 a	99 a	99 a	172 a	138 a
Liberty + AMS	36 oz + 1.7 lb	98 a	98 a	0 a	99 a	99 a	168 a	133 a
Liberty + Atrazine + AMS	22 oz + 1 pt + 1.7 lb	98 a	98 a	0 a	99 a	99 a	167 a	135 a
Liberty + Atrazine + AMS	29 oz + 1 pt + 1.7 lb	98 a	98 a	0 a	99 a	99 a	186 a	149 a
Liberty + Atrazine + AMS	36 oz + 1 pt + 1.7 lb	98 a	98 a	0 a	99 a	99 a	191 a	151 a
Liberty + Laudis + AMS	22 oz + 3 oz + 1.7 lb	98 a	98 a	0 a	99 a	99 a	182 a	146 a
Liberty + Laudis + AMS	29 oz + 3 oz + 1.7 lb	98 a	98 a	0 a	99 a	99 a	176 a	135 a
Liberty + Laudis + AMS	36 oz + 3 oz + 1.7 lb	98 a	98 a	0 a	99 a	99 a	172 a	145 a
Liberty + DiFlexx + AMS	22 oz + 10 oz + 1.7 lb	98 a	98 a	0 a	98 a	99 a	175 a	134 a
Liberty + DiFlexx + AMS	29 oz + 10 oz + 1.7 lb	98 a	98 a	0 a	99 a	99 a	171 a	139 a
Liberty + DiFlexx + AMS	36 oz + 10 oz + 1.7 lb	98 a	98 a	0 a	99 a	99 a	175 a	137 a
Epost & Post[1]								
Liberty + Atrazine + AMS & Liberty + AMS	22 oz + 1 pt + 1.7 lb & 29 oz + 1.7 lb	98 a	98 a	0 a	99 a	99 a	170 a	130 a
Liberty + Atrazine + AMS & Liberty + AMS	22 oz + 1 pt + 1.7 lb & 36 oz + 1.7 lb	98 a	98 a	0 a	99 a	99 a	169 a	140 a

[1]Balance Flexx (3 oz) + Atrazine (1 pt) applied Pre to all treatments.

RCB: 4 reps
Variety: DKC 46-36 RIB/P8906HR
Planting Date: 5/17/16
Pre: 5/17/16
Epost: 6/16/16 Corn V5, 12-14 in; Vele 0.5-1 in.
Post: 6/23/16 Corn

Soil: Silty Clay; 3.9% OM; 7.0 pH

Precipitation: (inches)
Pre: 1st week 0.68 2nd week 3.14
Epost: 1st week 0.63 2nd week 0.38
Post: 1st week 0.38 2nd week 0.74

Vele=Velvetleaf
Cowh=Common waterhemp
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Moderate to heavy weed pressure. Excellent weed control by all treatments. Increased Liberty rates did not affect yield. Two varieties with different trait packages were looked at to evaluate tolerance.

2016
ROUNDUP READY SOYBEAN DEMONSTRATION
Southeast Research Farm

Treatment	Rate/A	Vele 6/30/16	Cowh 6/30/16	Vele 7/15/16	Cowh 7/15/16	VCRR Bronzing 7/15/16	Vele 10/3/16	Cowh 10/3/16	Yield bu/A 10/3/16
Check	---	0 f	0 e	0 d	0 c	0 b	0 d	0 d	17 c
PPI & Post									
Treflan & RU Powermax + AMS	1.5 pt & 22 oz + 2 qt	30 d	91 c	85 c	99 a	0 b	94 b	95 c	43 ab
Prowl H2O & RU Powermax + AMS	3 pt & 22 oz + 2 qt	28 d	82 d	91 b	99 a	0 b	92 c	97 b	39 ab
Pre & Epost									
Authority MTZ & Anthem Maxx + RU Powermax + COC + AMS	14 oz & 3 oz + 22 oz + 1% + 1.7 lb	98 a	98 ab	99 a	99 a	0 b	99 a	98 a	51 ab
Pre & Post									
Sonic & Flexstar + Select Max + COC	7 oz & 0.75 pt + 12 oz + 0.25%	97 ab	99 a	99 a	99 a	0 b	99 a	99 a	49 ab
Authority MTZ & Avalanche Ultra + Section 3 + NIS	14 oz & 1.5 pt + 5.33 oz + 0.25%	90 abc	97 ab	85 c	99 a	0 b	90 c	95 c	32 b
Authority MTZ & Marvel + RU Powermax + COC + AMS	14 oz & 7.25 oz + 22 oz + 1% + 1.7 lb	91 abc	96 ab	99 a	99 a	14 a	99 a	99 a	43 ab
Sonic & Durango DMA + AMS	4 oz & 1 qt + 2.5%	98 a	98 ab	99 a	99 a	0 b	99 a	99 a	45 ab
Sonic & Durango DMA + AMS	6 oz & 1 qt + 2.5%	99 a	98 a	99 a	99 a	0 b	99 a	99 a	53 a
Surveil & Durango DMA + AMS	2.8 oz & 1 qt + 2.5%	99 a	97 ab	99 a	99 a	0 b	99 a	99 a	49 ab
Sonic + Dimetric & Durango DMA + AMS	4 oz + 4 oz & 1 qt + 2.5%	98 a	98 ab	99 a	99 a	0 b	99 a	99 a	53 a
Boundary & Flexstar GT + Dual Mag + AMS	1.8 pt & 3.5 pt + 1 pt + 1.7 lb	90 abc	97 ab	98 a	99 a	0 b	99 a	99 a	48 ab
Broadaxe XC & Flexstar GT + Dual Mag + AMS	25 oz & 3.5 pt + 1 pt + 1.7 lb	85 c	97 ab	97 a	99 a	0 b	99 a	99 a	47 ab
Boundary & Prefix + RU Powermax + AMS	1.8 pt & 2 pt + 22 oz + 1.7 lb	90 abc	97 ab	99 a	99 a	0 b	99 a	99 a	47 ab
Broadaxe XC & Prefix + RU Powermax + AMS	25 oz & 2 pt + 22 oz + 1.7 lb	84 c	96 ab	98 a	99 a	0 b	97 a	99 a	46 ab
Afforia + Dimetric & Cinch + Abundit Extra + AMS	2.5 oz + 5 oz & 1 pt + 32 oz + 2 qt	93 ab	97 ab	99 a	99 a	0 b	99 a	99 a	52 ab
Afforia + Dimetric & Abundit Extra + Assure II + Flexstar + NIS + AMS	2.5 oz + 4 oz & 32 oz + 5 oz + 12 oz + 0.25% + 2 qt	90 abc	94 b	99 a	99 a	0 b	99 a	99 a	51 ab
Optill + Zidua & RU Powermax + AMS	2 oz + 2 oz & 22 oz + 2 qt	98 a	98 a	99 a	99 a	0 b	99 a	99 a	48 ab
Zidua + Verdict & RU Pmax + Extreme + AMS	2.5 oz + 5 oz & 22 oz + 2.25 pt + 2 qt	95 ab	98 a	99 a	99 a	0 b	99 a	99 a	41 ab

Treatment	Rate/A	Vele 6/30/16	Cowh 6/30/16	Vele 7/15/16	Cowh 7/15/16	VCRR Bronzing 7/15/16	Vele 10/3/16	Cowh 10/3/16	Yield bu/A 10/3/16
Pre & Post									
Warrant & RU Powermax + AMS	1.5 qt & 22 oz + 2 qt	20 e	96 ab	89 bc	99 a	0 b	91 c	96 bc	33 ab
Panther & RU Powermax + AMS	2 oz & 22 oz + 2 qt	83 c	97 ab	97 a	98 a	0 b	99 a	98 a	38 ab
Fierce & RU Powermax + AMS	3 oz & 22 oz + 2 qt	88 bc	96 ab	99 a	99 a	0 b	99 a	99 a	35 ab
Valor + Dimetric & RU Powermax + AMS	2 oz + 5.33 oz & 22 oz + 2 qt	91 ab	98 ab	99 a	99 a	0 b	99 a	99 a	44 ab
Epost & Post									
RU Powermax + AMS & RU Powermax + AMS	22 oz + 2 qt & 22 oz + 2 qt	98 a	98 ab	99 a	97 b	0 b	98 a	95 c	45 ab

RCB: 4 reps
Variety: AG 1733
Planting Date: 5/19/16
PPI/Pre: 5/19/16
Epost: 6/16/16 Soy 2 tri, 5-7 in; Vele 1-3 in; Cowh 1-4 in.
Post: 7/1/16 Soy R1, 12-14 in; Vele 4-14 in; Cowh 2-6 in.

Precipitation: (inches)
Pre: 1st week 1.06 2nd week 2.76
Epost: 1st week 0.63 2nd week 0.38
Post: 1st week 0.74 2nd week 0.05

Soil: Clay; 3.8% OM; 7.4 pH

Vele=Velvetleaf
Cowh=Common waterhemp
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Very heavy velvetleaf and moderately heavy waterhemp pressure. The Southeast research farm was very wet early in the season and then became dry; the yields were somewhat affected by these conditions. The yield of the untreated check was severely reduced by weed pressure.

2016
LIBERTY LINK SOYBEAN DEMONSTRATION
Southeast Research Farm

Treatment	Rate/A	Vele 6/30/16	Cowh 6/30/16	Vele 7/15/16	Cowh 7/15/16	Cowh 10/3/16
Check	---	0 c	0 c	0 b	0 c	0 c
Pre & Post						
Authority First & Liberty + AMS	6.5 oz & 29 oz + 1.7 lb	99 a	99 a	99 a	99 a	99 a
Valor & Liberty + Zidua + AMS	2.5 oz & 29 oz + 2 oz + 1.7 lb	93 ab	96 a	99 a	99 a	99 a
Fierce & Liberty + AMS	3.5 oz & 29 oz + 1.7 lb	95 ab	98 a	99 a	99 a	99 a
Optill + Outlook (Optill Pro) & Liberty + AMS	2 oz + 10 oz & 29 oz + 1.7 lb	99 a	99 a	99 a	99 a	99 a
Authority MTZ & Cheetah + AMS	14 oz & 29 oz + 1.5 lb	95 ab	98 a	99 a	99 a	99 a
Epost & Post						
Cheetah + AMS & Cheetah + AMS	29 oz + 1.5 lb & 29 oz + 1.5 lb	92 b	90 b	98 a	98 b	93 b

RCB: 4 reps
Variety: CZ 1845 LL
Planting Date: 5/19/16
Pre: 5/19/16
Epost: 6/16/16 Soy 2 tri, 5-7 in; Cowh 1-4 in; Vele 1-3 in.
Post: 7/1/16 Soy 6 tri, 8-12 in; Cowh 2-6 in; Vele 4-14 in.

Precipitation: (inches)
Pre: 1st week 1.06 2nd week 2.76
Epost: 1st week 0.63 2nd week 0.38
Post: 1st week 0.74 2nd week 0.05

Soil: Clay; 3.8% OM; 7.4 pH

Cowh=Common waterhemp
Vele=Velvetleaf

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Very heavy velvetleaf and moderately heavy waterhemp. Weed pressure and soybean growth were affected by the wet followed by dry conditions of the season. Liberty systems provided excellent control of both velvetleaf and waterhemp.

2016
DICAMBA SOYBEAN DEMONSTRATION
Southeast Research Farm

Treatment	Rate/A	Vele 6/30/16	Cowh 6/30/16	Vele 7/15/16	Cowh 7/15/16	Yield bu/A 10/3/16
Check	---	0 d	0 c	0 b	0 b	11 c
Pre & Post						
Authority First &	6.5 oz &	99 a	96 ab	99 a	99 a	40 a
RU Powermax + DGA dicamba + Class Act Ridion	32 oz + 16 oz + 1%					
Panther &	2.5 oz &	94 c	95 b	99 a	99 a	31 b
RU Powermax + DGA dicamba + Class Act Ridion	32 oz + 16 oz + 1%					
Fierce &	3.5 oz &	96 b	96 b	99 a	99 a	28 b
RU Powermax + DGA dicamba + Class Act Ridion	32 oz + 16 oz + 1%					
Afforia &	2.5 oz &	96 b	97 ab	99 a	99 a	33 ab
RU Powermax + DGA dicamba + Class Act Ridion	32 oz + 16 oz + 1%					
Authority MTZ &	14 oz &	97 ab	97 ab	99 a	99 a	35 ab
RU Powermax + DGA dicamba + Class Act Ridion	32 oz + 16 oz + 1%					
Epost & Post						
RU Powermax + DGA dicamba + Class Act Ridion &	32 oz + 16 oz + 1% &	98 a	98 a	99 a	99 a	33 ab
RU Powermax + DGA dicamba + Class Act Ridion	32 oz + 16 oz + 1%					

RCB: 4 reps
Variety: AG 17X6
Planting Date: 5/19/16
Pre: 5/19/16
Epost: 6/16/16 Soy 2 tri, 5-7 in; Cowh 1-4 in; Vele 1-3 in.
Post:7/1/16 Soy R1, 12-14 in; Cowh 4-8 in; Vele

Precipitation: (inches)

Pre:	1st week 1.06	2nd week 2.76
Epost:	1st week 0.63	2nd week 0.38
Post:	1st week 0.74	2nd week 0.05

Soil: Clay; 3.8% OM; 7.4 pH

Cowh=Common waterhemp
Vele=Velvetleaf

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Very heavy velvetleaf and moderately heavy waterhemp. Wet followed by dry conditions effected weed pressure and soybean growth. Post emergence treatments were applied with TTI (coarse) nozzles. Heavy weed pressure severely affected yield of the check. Dicamba systems provided excellent weed control.

2016
TWO PASS DICAMBA PROGRAMS in NO-TILL SOYBEANS
Southeast Research Farm

Treatment	Rate/A	Dali 6/1/16		Mata 6/1/16		Mata 6/30/16		Colq 6/30/16		VCRR-Necrosis 7/7/16		Mata 7/29/16		Colq 7/29/16		Cowh 7/29/16		Yield bu/A 10/3/16	
EPP & Post																			
Afforia + RU Pmax + DGA Dicamba & RU Powermax + DGA Dicamba	2.5 oz + 22 oz + 16 oz & 22 oz + 16 oz	98	a	99	a	99	a	99	a	0	b	99	a	99	a	98	a	43	a
Afforia + RU Pmax + DGA Dicamba & RU Pmax + Cinch + DGA Dicamba	2.5 oz + 22 oz + 16 oz & 22 oz + 1 pt + 16 oz	97	a	99	a	99	a	99	a	0	b	99	a	99	a	97	a	42	a
Afforia + RU Pmax + DGA Dicamba & RU Powermax + Prefix	2.5 oz + 22 oz + 16 oz & 22 oz + 2 pt	97	a	99	a	99	a	99	a	12	a	99	a	99	a	97	a	37	a
Enlite + RU Pmax + DGA Dicamba & RU Powermax + DGA Dicamba	2.8 oz + 22 oz + 16 oz & 22 oz + 16 oz	99	a	99	a	99	a	99	a	0	b	99	a	99	a	98	a	40	a
Enlite + RU Pmax + DGA Dicamba & RU Pmax + Cinch + DGA Dicamba	2.8 oz + 22 oz + 16 oz & 22 oz + 1 pt + 16 oz	99	a	99	a	99	a	99	a	0	b	99	a	99	a	97	a	36	a
Enlite + RU Pmax + DGA Dicamba & RU Powermax + Prefix	2.8 oz + 22 oz + 16 oz & 22 oz + 2 pt	98	a	97	a	99	a	99	a	13	a	99	a	99	a	97	a	41	a
Check	---	0	b	0	b	0	b	0	b	0	b	0	b	0	b	0	b	9	b

RCB: 3 reps
Variety: AG 12X6
Planting Date: 5/25/16
EPP: 5/17/16 Dali 8-12 in. diam.; Mata 2-4 in; Colq 1-2 in; Cowh 0.25-0.5 in.
Post: 7/1/16 Soy 4-5 tri, 8-10 in; Cowh 2-10 in.

Precipitation: (inches)
EPP: 1st week 0.68 2nd week 3.14
Post: 1st week 0.74 2nd week 0.05

Soil: Clay; 3.1% OM; 7.1 pH

Dali=Dandelion
Mata=Marestail
Colq=Common lambsquarters
Cowh=Common waterhemp
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Heavy weed pressure as indicated by reduced yield in check. All treatments provided excellent control of the weeds throughout the season. Burndown treatments provided good control of dandelion and marestail.

2016
SOYBEAN SYSTEM COMPARISONS
Southeast Research Farm

Treatment	Rate/A	Vele 7/7/16	Cowh 7/7/16	VCRR 7/7/16	Vele 7/21/16	Cowh 7/21/16	Grft 10/3/16	Vele 10/3/16	Cowh 10/3/16	Yield bu/A 10/3/16
Pre & Post										
Check - **RR2X**	---	0 c	0 b	0 a	0 c	0 c	0 c	0 d	0 b	5 b
Rowel & Roundup Xtend	2 oz & 64 oz	99 a	99 a	0 a	99 a	99 a	99 a	99 a	99 a	41 a
Rowel + XtendiMax & RU Xtend	2 oz + 22 oz & 64 oz	99 a	99 a	0 a	99 a	99 a	99 a	99 a	99 a	42 a
Rowel + XtendiMax & RU Xtend + Warrant	2 oz + 22 oz & 64 oz + 48 oz	99 a	99 a	0 a	99 a	99 a	99 a	99 a	99 a	42 a
Check - **RR2**	---	0 c	0 b	0 a	0 c	0 c	0 c	0 d	0 b	4 b
Rowel & RU Powermax	2 oz & 32 oz	99 a	99 a	0 a	98 a	99 a	99 a	99 a	99 a	43 a
Warrant + Tricor DF & RU Powermax	48 oz + 5 oz & 32 oz	99 a	99 a	0 a	99 a	99 a	99 a	98 a	99 a	47 a
Warrant + Tricor DF & RU Powermax + Warrant Ultra	48 oz + 5 oz & 32 oz + 50 oz	99 a	99 a	0 a	98 a	98 b	99 a	97 ab	99 a	46 a
Check - **LL**	---	0 c	0 b	0 a	0 c	0 c	0 c	0 d	0 b	5 b
Valor & Liberty	2 oz & 29 oz	96 b	99 a	0 a	91 b	99 a	98 a	90 c	99 a	40 a
Authority Maxx & Liberty	6.4 oz & 29 oz	97 a	99 a	0 a	92 b	99 a	99 a	95 b	99 a	45 a
Authority Maxx & Liberty + Zidua	6.4 oz & 29 oz + 2 oz	99 a	99 a	0 a	97 a	99 a	95 b	96 ab	99 a	38 a

RCB: 4 reps
Variety: AG 17X6, AG 1733, CZ 1845
Planting Date: 5/19/16
Pre: 5/19/16
Post: 6/23/16 Soy 3-4 tri, 8 in; Vele 3-8 in; Cowh 2-6 in; Grft 3-8 in.

Precipitation: (inches)
Pre: 1st week 1.06 2nd week 2.76
Post: 1st week 0.38 2nd week 0.74

Soil: Clay; 3.8% OM; 7.4 pH

Vele=Velvetleaf
Cowh=Common waterhemp
Grft=Green foxtail
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Moderate to heavy weed pressure. The study compared regular Roundup systems to Liberty systems and new Roundup Xtend systems. Postemergence treatments were applied with TTI (coarse) nozzles for the RR2X soybeans and XR (medium) nozzles for the RR2 and LL soybeans. Very wet early and then very dry most of the summer. All systems provided excellent weed control and comparable yields.

2016
SOYBEAN WEED CONTROL COMPARISONS-SOUTH
Southeast Research Farm

Treatment	Rate/A		Vele 7/7/16	Cowh 7/7/16	Vele 7/12/16	Cowh 7/12/16	Vele 7/21/16	Cowh 7/21/16	Vele 8/9/16	Cowh 8/9/16
Pre & Epost[1] or Post[2]										
Rowel &	3 oz &	1	87 c	95 b	98 a	96 ab	96 ab	95 c	95 ab	86 e
RU Powermax + Warrant Ultra + AMS	32 oz + 50 oz + 2%	2	--	--	86 b	93 c	98 a	97 abc	93 ab	95 ab
Rowel &	3 oz &	1	92 bc	98 a	99 a	99 a	99 a	98 ab	90 ab	91 a-d
RU Powermax + Warrant +	32 oz + 48 oz +									
AMS + Cobra	2% + 10 oz									
Rowel &	3 oz &	2	--	--	81 c	92 c	99 a	97 abc	94 ab	96 a
RU Powermax + Warrant + AMS	32 oz + 48 oz + 2%									
Rowel + XtendiMax &	3 oz + 22 oz &	1	92 bc	97 a	98 a	98 a	99 a	98 ab	95 ab	91 a-e
XtendiMax + RU Powermax +	22 oz + 28.4 oz +	2	--	--	96 a	95 bc	96 ab	96 bc	92 ab	87 cde
Warrant Ultra + Impetro	50 oz + 1%									
Rowel + XtendiMax &	3 oz + 66 oz &	1	92 bc	99 a	98 a	99 a	99 a	98 ab	94 ab	93 ab
XtendiMax + RU Powermax +	22 oz + 28.4 oz +									
Cobra + Impetro	10 oz + 1%									
Rowel + XtendiMax &	3 oz + 22 oz &	2	--	--	94 a	93 c	97 ab	97 abc	92 ab	86 de
XtendiMax + RU Powermax +	22 oz + 28.4 oz +									
Cobra + Impetro	10 oz + 1%									
Enlist Duo + Envive &	56 oz + 2.5 oz &	1	99 a	99 a	99 a	99 a	99 a	99 a	97 a	96 a
Enlist Duo + Prefix	56 oz + 40 oz	2	--	--	99 a	95 bc	99 a	96 abc	94 ab	89 b-e
Boundary &	24 oz &	1	92 bc	99 a	94 a	99 a	94 b	99 a	91 ab	95 a
Liberty + Prefix + AMS	29 oz + 40 oz + 1%	2	--	--	97 a	97 ab	94 b	96 abc	87 b	89 b-e
Authority MTZ &	11 oz &	1	95 ab	98 a	98 a	98 ab	99 a	97 abc	94 ab	92 abc
RU Powermax + AMS	32 oz + 2%	2	--	--	89 b	95 bc	97 ab	97 abc	92 ab	90 a-e
Sonic &	3 oz &	1	99 a	99 a	99 a	98 ab	99 a	98 ab	97 a	93 ab
RU Powermax + AMS	32 oz + 2%	2	--	--	99 a	96 abc	99 a	97 abc	97 a	93 ab
Check	---		0 d	0 c	0 d	0 d	0 c	0 d	0 c	0 f

RCB: 4 reps
Pre: 5/25/16
Epost: 7/1/16 Cowh 2-12 in; Vele 2-10 in.
Post: 7/8/16 Cowh 5-16 in; Vele 4-14 in.

Precipitation: (inches)
Pre: 1st week 2.76 2nd week 0.02
Epost: 1st week 0.74 2nd week 0.05
Post: 1st week 0.05 2nd week 0.53

Soil: Silty Clay Loam; 3.7% OM; 7.2 pH

Cowh=Common waterhemp
Vele=Velvetleaf

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Moderate velvetleaf and waterhemp pressure. Study was done without planting soybeans to compare different weed control systems. Study was very wet early then dry during summer months.

2016
PANTHER PRO PREPLANT & PREEMERGENCE
Southeast Research Farm

Treatment	Rate/A	Dali 6/1/16	Mata 6/1/16	Colq 6/1/16	Dali 6/24/16	Cowh 6/24/16	Cowh 7/7/16	Dali 7/7/16	Mata 7/7/16	Yield bu/A 10/3/16
Check	---	0 d	0 b	0 b	0 d	0 c	0 b	0 c	0 c	12 b
EPP & Post										
Panther Pro + MSO & Credit Xtreme	15 oz + 1% & 22 oz	90 a	99 a	99 a	47 b	91 ab	93 a	70 a	99 a	42 a
Authority Assist + MSO & Credit Xtreme	10 oz + 1% & 22 oz	66 b	99 a	99 a	60 b	95 a	95 a	72 a	94 a	44 a
Pre & Post										
Panther Pro + MSO & Credit Xtreme	12 oz + 1% & 22 oz	40 c	94 a	99 a	60 b	93 ab	94 a	67 a	97 a	39 a
Panther Pro + MSO & Credit Xtreme	15 oz + 1% & 22 oz	38 c	96 a	99 a	30 c	92 ab	96 a	67 a	93 a	42 a
Authority Assist + MSO & Credit Xtreme	8 oz + 1% & 22 oz	47 c	94 a	99 a	0 d	92 ab	92 a	37 b	27 b	39 a
EPP & Pre & Post										
Spitfire + Credit Xtreme & Panther SC + MSO & Credit Xtreme	32 oz + 22 oz & 2.5 oz + 1% & 22 oz	99 a	99 a	99 a	96 a	88 b	91 a	87 a	93 a	41 a

RCB: 3 reps
Variety: AG 12X6
Planting Date: 5/25/16
EPP: 5/17/16
Pre: 5/25/16 Dali 10-14 in diam.; Colq 3-5 in; Cowh 0.5-2 in.
Post: 6/23/16 Soy 2-3 tri, 6-9 in; Dali 6-14 in diam.; Cowh 3-5 in; Mata 4-12 in.

Precipitation: (inches)

EPP:	1st week 0.68	2nd week 3.14
Pre:	1st week 2.76	2nd week 0.02
Post:	1st week 0.38	2nd week 0.74

Soil: Clay; 3.1% OM; 7.1 pH

Dali=Dandelion
Mata=Marestail
Colq=Common lambsquarters
Cowh=Common waterhemp

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Moderate to heavy weed pressure. Panther Pro is a new tank mix that contains flumioxazin “Valor” + imazethapyr “Pursuit” + metribuzin. Registration is expected for spring 2017. Treatments were applied in no-till soybeans. Several treatments look promising for early no-till weeds.

2016
SOYBEAN PREEMERGENCE COMMON WATERHEMP CONTROL
Southeast Research Farm

Treatment	Rate/A	Vele 6/14/16	Cowh 6/14/16	Vele 6/30/16	Cowh 6/30/16	Vele 7/12/16	Cowh 7/12/16
Check	---	0 c	0 c	0 c	0 b	0 c	0 c
Post							
Presidual	1.8 pt	96 b	99 a	86 b	95 a	86 b	98 a
Sonic	3.2 oz	98 a	99 ab	94 a	95 a	96 a	95 ab
Valor	2 oz	95 b	98 b	87 b	95 a	89 b	93 b
Valor + Dimetric	2 oz + 5.8 oz	98 a	99 ab	95 a	96 a	95 a	96 ab
Spartan + Dimetric + Pursuit	2.88 oz + 4 oz + 1.92 oz	99 a	99 a	96 a	95 a	98 a	95 ab

RCB: 4 reps
Variety: AG 1733
Planting Date: 5/19/16
Pre: 5/19/16

Precipitation: (inches)
Pre: 1st week 1.06 2nd week 2.76

Soil: Clay; 3.8% OM; 7.4 pH

Vele=Velvetleaf
Cowh=Common waterhemp

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Heavy velvetleaf and moderately heavy waterhemp pressure. Treatments were activated by early moisture followed by a long dry period resulting in good control for all treatments.

2016
WEED CONTROL in SOYBEAN with AUTHORITY & ANTHEM MAXX
Southeast Research Farm

Treatment	Rate/A	Vele 6/24/16	Cowh 6/24/16	Vele 7/7/16	Cowh 7/7/16	VCRR Chlorosis 7/7/16	Vele/Cowh 7/29/16	Vele/Cowh 8/22/16	Yield bu/A 10/3/16
Pre & Post									
Authority Assist & Anthem Maxx + RU Powermax + COC + AMS	6 oz & 3 oz + 2 pt + 1 pt + 1.7 lb	97 a	96 a	99 a	99 a	3 bc	99 a	99 a	37 a
Authority MTZ & Anthem Maxx + RU Powermax + COC + AMS	14 oz & 3 oz + 2 pt + 1 pt + 1.7 lb	94 a	97 a	99 a	99 a	4 b	99 a	99 a	36 a
Authority Elite & Marvel + RU Powermax + COC + AMS	28 oz & 7.25 oz + 2 pt + 1 pt + 1.7 lb	96 a	98 a	99 a	99 a	10 a	99 a	99 a	39 a
Fierce & Cobra + RU Powermax + COC + AMS	3 oz & 10 oz + 2 pt + 1 pt + 1.7 lb	97 a	98 a	99 a	99 a	10 a	99 a	99 a	39 a
Rowel & Warrant + RU Powermax + AMS	3 oz & 1.5 qt + 2 pt + 1.7 lb	97 a	97 a	99 a	99 a	0 c	99 a	99 a	40 a
Check	---	0 b	0 b	0 b	0 b	0 c	0 b	0 b	10 b

RCB: 4 reps
Variety: AG 1733
Planting Date: 5/19/16
Pre: 5/19/16
Post: 6/23/16 Soy 4 tri, 6-8 in; Cowh 2-8 in; Vele 2-6 in.

Precipitation: (inches)
Pre: 1st week 1.06   2nd week 2.76
Post: 1st week 0.38   2nd week 0.74

Soil: Clay; 3.8% OM; 7.4 pH

Cowh=Common waterhemp
Vele=Velvetleaf
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Very heavy velvetleaf and moderately heavy waterhemp. Weed pressure and growth were affected by moisture conditions. Yield of check was severely affected by weed pressure. All treatments provided excellent weed control.

2016
SOYBEAN PROGRAMS
Southeast Research Farm

Treatment	Rate/A	VCRR 7/7/16	Vele 7/7/16	Cowh 7/7/16	Vele 7/29/16	Cowh 7/29/16	Yield bu/A 10/3/16
Check	---	0 c	0 c	0 c	0 c	0 c	18 c
Pre & Post							
Afforia & Cinch + Assure II + Flexstar + Abundit Extra + COC + AMS	2.5 oz & 16 oz + 5 oz + 12 oz + 32 oz + 0.25% + 2 lb	15 a	99 a	99 a	99 a	99 a	35 b
Afforia + Metribuzin & Assure II + Flexstar + Abundit Extra + COC + AMS	2.5 oz + 0.25 lb & 5 oz + 12 oz + 32 oz + 0.25% + 2 lb	8 b	99 a	99 a	99 a	99 a	39 ab
Enlite & Assure II + Abundit Extra + COC + AMS	2.8 oz & 5 oz + 32 oz + 0.25% + 2 lb	0 c	99 a	99 a	99 a	99 a	42 a
Enlite & Cinch + Assure II + COC + AMS	2.8 oz & 8 oz + 6 oz + 1% + 2 lb	0 c	99 a	98 a	94 b	91 b	39 ab
Post							
Abundit Extra + AMS	32 oz + 2 lb	0 c	89 b	93 b	98 a	93 b	32 b

RCB: 4 reps
Variety: AG 1733
Planting Date: 5/19/16
Pre: 5/19/16
Post: 7/1/16 Soy 6 tri, 8-12 in; Cowh 6-10 in; Vele 8-15 in.

Soil: Clay; 3.8% OM; 7.4 pH

Precipitation: (inches)
Pre: 1st week 1.06 2nd week 2.76
Post: 1st week 0.74 2nd week 0.05

Cowh=Common waterhemp
Vele=Velvetleaf
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Heavy velvetleaf and moderately heavy waterhemp pressure as shown by the yield of the check. Good to excellent control of velvetleaf and waterhemp. Yield results showed only one pre and post treatment was significantly greater compared to the post glyphosate only treatment.

2016
COBRA + LIBERTY for WATERHEMP CONTROL in LL SOYBEANS
Southeast Research Farm

Treatment	Rate/A	VCRR Leaf burn 6/30/16	Vele 6/30/16	Cowh 6/30/16	Vele 7/7/16	Cowh 7/7/16	VCRR 7/7/16	Vele 7/21/16	Cowh 7/21/16	Yield bu/A 10/3/16
Check	---	0 c	0 c	0 c	0 b	0 c	0 a	0 b	0 c	12 c
Post										
Liberty + AMS	29 oz + 3 lb	0 c	98 b	97 b	99 a	95 b	0 a	99 a	81 b	40 b
Liberty + Cobra + AMS	29 oz + 8 oz + 3 lb	10 a	99 a	98 a	99 a	98 a	0 a	99 a	93 a	46 ab
Liberty + Cobra + AMS	29 oz + 10 oz + 3 lb	10 a	99 a	99 a	99 a	97 a	0 a	99 a	92 a	47 ab
Liberty + Cobra + AMS	29 oz + 12.5 oz + 3 lb	10 a	99 a	98 a	99 a	98 a	0 a	99 a	95 a	53 a
Liberty + Cobra + COC + AMS	29 oz + 8 oz + 1 pt + 3 lb	10 a	99 a	99 a	99 a	98 a	0 a	99 a	91 a	44 ab
Liberty + Flexstar + COC + AMS	29 oz + 16 oz + 1 pt + 3 lb	5 b	99 a	99 a	99 a	98 a	0 a	99 a	96 a	51 a
Liberty + Ultra Blazer + COC + AMS	29 oz + 16 oz + 1 pt + 3 lb	5 b	99 a	99 a	99 a	99 a	0 a	99 a	94 a	48 ab
Liberty + Cobra + Resource + COC + AMS	29 oz + 8 oz + 3 oz + 1 pt + 3 lb	10 a	99 a	99 a	99 a	98 a	0 a	99 a	94 a	48 ab

RCB: 4 reps
Variety: CZ 1845 LL
Planting Date: 5/19/16
Post: 6/23/16 Soy 2-3 tri, 5-7 in; Cowh 2-8 in; Vele 3-5 in.

Precipitation: (inches)
Post: 1st week 0.38 2nd week 0.74

Soil: Silty Clay Loam; 3.7% OM; 7.2 pH

Cowh=Common waterhemp
Vele=Velvetleaf
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Very heavy velvetleaf and moderately heavy waterhemp. Weed pressure and plant growth were affected by moisture conditions. Yield of check severely affected by weed pressure. One pass systems required a tankmix partner to provide good waterhemp control.

2016
INCREASED LIBERTY RATES in LL SOYBEANS
Southeast Research Farm

Treatment	Rate/A	Vele 6/14/16	VCRR 6/14/16	Vele 7/7/16	Cowh 7/7/16	VCRR 7/7/16	Vele 7/29/16	Cowh 7/29/16	Yield bu/A 10/3/16
Check	---	0 b	0 a	0 b	0 b	0 c	0 b	0 b	20 b
Pre & Post									
Authority First & Liberty + AMS	6.5 oz & 29 oz + 1.7 lb	97 a	0 a	99 a	99 a	0 c	99 a	99 a	37 a
Authority First & Liberty + AMS	6.5 oz & 36 oz + 1.7 lb	97 a	0 a	99 a	99 a	0 c	99 a	99 a	41 a
Authority First & Liberty + AMS	6.5 oz & 43 oz + 1.7 lb	97 a	0 a	99 a	99 a	0 c	99 a	99 a	43 a
Pre & Epost									
Auth. First & Liberty + Cadet + AMS	6.5 oz & 29 oz + 0.5 oz + 1.7 lb	97 a	0 a	99 a	99 a	0 c	99 a	99 a	42 a
Auth. First & Liberty + Anthem + AMS	6.5 oz & 29 oz + 7 oz + 1.7 lb	97 a	0 a	99 a	99 a	0 c	99 a	99 a	41 a
Pre & Post & Lpost									
Auth. First & Liberty + AMS & Liberty + AMS	6.5 oz & 29 oz + 1.7 lb & 29 oz + 1.7 lb	97 a	0 a	99 a	99 a	0 c	99 a	99 a	44 a
Auth. First & Liberty + AMS & Liberty + AMS	6.5 oz & 36 oz + 1.7 lb & 36 oz + 1.7 lb	97 a	0 a	99 a	99 a	0 c	99 a	99 a	40 a
Auth. First & Liberty + AMS & Liberty + AMS	6.5 oz & 43 oz + 1.7 lb & 43 oz + 1.7 lb	97 a	0 a	99 a	99 a	0 c	99 a	99 a	38 a
Authority MTZ & Liberty + Marvel + COC + AMS & Liberty + AMS	14 oz & 29 oz+7.25 oz +0.5%+1.7 lb & 29 oz + 1.7 lb	96 a	0 a	99 a	99 a	20 a	99 a	99 a	41 a
Valor & Liberty + Flexstar + AMS & Liberty + AMS	2 oz & 29 oz + 0.75 pt + 1.7 lb & 29 oz + 1.7 lb	96 a	0 a	99 a	99 a	10 b	99 a	99 a	38 a

RCB: 4 reps
Variety: CZ 1845 LL
Planting Date: 5/19/16
Pre: 5/19/16
Epost: 6/16/16 Soy 2 tri, 5-7 in; Cowh 1-4 in; Vele 1-3 in.
Post: 7/1/16 Soy 6 tri, 8-12 in; Cowh 2-6 in; Vele 4-14 in.
Lpost: 7/8/16 Soy R1, 12-16 in.

Precipitation: (inches)

Pre:	1st week 1.06	2nd week 2.76
Epost:	1st week 0.63	2nd week 0.38
Post:	1st week 0.74	2nd week 0.05
Lpost:	1st week 0.05	2nd week 0.53

Soil: Clay; 3.8% OM; 7.4 pH

Cowh=Common waterhemp
Vele=Velvetleaf
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Moderate to heavy weed pressure. No effect observed from increased Liberty rates on soybeans. All treatments provided excellent weed control.

2016
METRIBUZIN CROP RESPONSE on HIGH pH SOILS
Southeast Research Farm

Treatment	Rate/A	Vele 6/14/16	VCRR Leaf Drop 6/14/16	Vele 6/24/16	Cowh 6/24/16	VCRR 6/24/16	Vele 6/30/16	Cowh 6/30/16	Vele 7/7/16	Cowh 7/7/16	Yield bu/A 10/3/16
Check	---	0 c	0 b	0 e	0 d	0 a	0 c	0 e	0 d	0 b	32 b
Pre											
Dimetric	4 oz	92 b	0 b	88 d	92 c	0 a	81 b	94 d	87 c	99 a	42 a
Dimetric	5.3 oz	95 ab	0 b	90 cd	96 ab	0 a	83 b	97 bc	90 c	99 a	41 a
Dimetric	8 oz	98 a	0 b	94 ab	97 ab	0 a	94 a	97 abc	98 a	99 a	42 a
Dimetric	16 oz	98 a	9 a	97 a	98 a	0 a	97 a	98 a	99 a	99 a	45 a
Presidual	1.3 pt	93 ab	0 b	89 d	96 b	0 a	82 b	96 c	88 c	99 a	41 a
Presidual	1.8 pt	97 a	0 b	93 bc	98 a	0 a	93 a	97 abc	94 b	99 a	44 a
Presidual	2.8 pt	98 a	0 b	95 ab	98 a	0 a	96 a	98 ab	97 a	99 a	46 a

RCB: 4 reps
Variety: AG 1733
Planting Date: 5/19/16
Pre: 5/19/16

Soil: Clay; 3.8% OM; 7.4 pH

Precipitation: (inches)
Pre: 1st week 1.06 2nd week 2.76

Vele=Velvetleaf
Cowh=Common waterhemp
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Heavy velvetleaf and moderately heavy waterhemp. Treatments provided excellent control of waterhemp and good to excellent control of velvetleaf. Minimal crop injury was observed early with the highest dimetric rate. Yields were slightly greater with the high herbicide rates but not significantly.

2016
FLEXSTAR with ADJUVANT COMPARISONS
Southeast Research Farm

Treatment	Rate/A	Vele 7/7/16	Cowh 7/7/16	Cowh 7/12/16	Vele 7/12/16	Vele 7/28/16	Cowh 7/28/16
Post							
Flexstar	1 pt	53 c	72 c	63 d	45 a	38 b	45 b
Flexstar + Destiny HC	1 pt + 8 oz	63 b	77 b	71 c	55 a	53 ab	58 a
Flexstar + Destiny HC + Interlock	1 pt + 8 oz + 4 oz	68 ab	82 a	76 abc	50 a	55 ab	60 a
Flexstar + Strikelock	1 pt + 8 oz	70 a	84 a	79 ab	50 a	50 ab	53 ab
Flexstar + Destiny HC	1 pt + 12 oz	70 a	86 a	79 ab	54 a	55 ab	58 a
Flexstar + Destiny HC + Interlock	1 pt + 12 oz + 4 oz	73 a	88 a	81 a	55 a	61 a	53 ab
Flexstar + Strikelock	1 pt + 12 oz	73 a	87 a	74 bc	50 a	61 a	53 ab
Check	---	0 d	0 d	0 e	0 b	0 c	0 c

RCB: 4 reps
Variety: CZ 1845 LL
Planting Date: 5/19/16
Post: 7/1/16 Soy 4 tri, 8-10 in; Vele 6-14 in; Cowh 4-18 in.

Precipitation: (inches)
Post: 1st week 0.74 2nd week 0.05

Soil: Silty Clay Loam; 3.7% OM; 7.2 pH

Vele=Velvetleaf
Cowh=Common waterhemp

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Heavy velvetleaf and waterhemp densities. Weed pressure and growth were affected by moisture conditions. Early ratings showed weed control differences however fewer differences were observed later in the season.

2016
HUSKIE in SORGHUM
Southeast Research Farm

Treatment	Rate/A	Vele 6/24/16	Cowh 6/24/16	VCRR 6/24/16	Vele 7/7/16	Cowh 7/7/16	VCRR 7/7/16	Vele 7/15/16	Cowh 7/15/16	Yield bu/A 10/28/16
Check	---	0 b	0 b	0 a	0 c	0 c	0 a	0 c	0 c	9 c
Post										
Huskie + Atrazine + AMS + NIS + Iron Chelate	13 oz + 1 pt + 1 lb + 0.25% + 13 oz	99 a	99 a	0 a	94 a	98 a	0 a	97 a	98 a	117 a
Huskie + Atrazine + AMS + NIS + Iron Chelate	16 oz + 1 pt + 1 lb + 0.25% + 16 oz	99 a	99 a	0 a	96 a	99 a	0 a	97 a	99 a	121 a
Huskie + Atrazine + 2,4-D ester + AMS + NIS + Iron Chelate	13 oz + 1 pt + 4 oz + 1 lb + 0.25% + 13 oz	99 a	99 a	0 a	95 a	99 a	0 a	96 a	99 a	112 a
Huskie + Atrazine + Banvel + AMS + NIS + Iron Chelate	13 oz + 1 pt + 4 oz + 1 lb + 0.25% + 13 oz	99 a	99 a	0 a	94 a	99 a	0 a	97 a	99 a	112 a
Huskie + Atrazine + Starane Ultra + AMS + NIS + Iron Chelate	13 oz + 1 pt + 3 oz + 1 lb + 0.25% + 13 oz	99 a	99 a	0 a	96 a	99 a	0 a	97 a	98 a	114 a
Atrazine + Buctril	1 pt + 1 pt	99 a	97 a	0 a	88 b	85 b	0 a	91 b	90 b	93 b

RCB: 4 reps
Variety: DK 28E
Planting Date: 5/25/16
Post: 6/15/16 Sorghum V4 5-8 in; Vele 1-5 in; Cowh 1-5 in.

Soil: Silty Clay; 4.0% OM; 7.8 pH

Precipitation: (inches)
Post: 1st week 0.63 2nd week 0.38

Vele=Velvetleaf
Cowh=Common waterhemp
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Very heavy velvetleaf and waterhemp pressure. Full season weed control was required to be in the top yield group.

2016
EVALUATION of SHARPEN with ADJUVANTS
Southeast Research Farm

Treatment	Rate/A	Cowh 6/14/16	Colq 6/14/16	Prle 6/14/16	Cowh 6/24/16	Colq 6/24/16	Prle 6/24/16	Cowh 7/7/16	Colq 7/7/16	Mata 7/7/16
Burndn										
Sharpen	1 oz	60 b	38 c	15 b	43 b	30 b	5 b	20 c	20 e	54 b
Sharpen + Destiny HC	1 oz + 8 oz	93 a	75 b	98 a	86 a	50 a	99 a	53 b	30 de	98 a
Sharpen + Destiny HC + Interlock	1 oz + 8 oz + 4 oz	93 a	77 ab	98 a	85 a	50 a	99 a	63 ab	38 cd	99 a
Sharpen + Strikelock	1 oz + 8 oz	92 a	75 b	99 a	84 a	53 a	99 a	58 ab	45 bc	99 a
Sharpen + Destiny HC	1 oz + 12 oz	95 a	79 ab	99 a	86 a	55 a	99 a	59 ab	50 bc	99 a
Sharpen + Destiny HC + Interlock	1 oz + 12 oz + 4 oz	94 a	82 a	98 a	90 a	53 a	99 a	69 a	53 b	99 a
Sharpen + Strikelock	1 oz + 12 oz	95 a	80 ab	99 a	85 a	50 a	99 a	71 a	70 a	99 a
Check	---	0 c	0 d	0 c	0 c	0 c	0 b	0 d	0 f	0 c

RCB: 4 reps
Burndn: Cowh 1-5 in; Colq 3-6 in;
Prle 10-20 in; Mata 3-12 in.

Soil: Clay; 3.1% OM; 7.1 pH

Precipitation: (inches)
Burndn: 1st week 0.21 2nd week 0.63

Cowh=Common waterhemp
Colq=Common lambsquarters
Prle=Prickly lettuce
Mata=Marestail

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: Burndown treatments provided excellent control of marestail and prickly lettuce. Waterhemp was controlled early with additives, however treatments did not control later emerging flushes. Lambsquarters control was somewhat variable.

2016
COVER CROP BURNDOWN
Southeast Research Farm

Treatment	Rate/A	Grass 6/1/16	Rape 6/1/16	Hairy Vetch 6/1/16	Dali 6/1/16	Whcl 6/1/16	Scurf pea 6/1/16
Check	---	0 e	0 e	0 f	0 e	0 e	0 e
Burndn							
RU Powermax + AMS	22 oz + 2.5 lb	99 a	97 a	94 a	85 b	25 d	99 a
RU Powermax + AMS	44 oz + 2.5 lb	99 a	99 a	98 a	97 a	99 a	99 a
Gramoxone + NIS	1 qt + 0.25%	43 c	40 c	50 d	20 d	20 de	50 c
Gramoxone + NIS	2 qt + 0.25%	75 b	70 b	68 c	30 c	30 cd	80 b
2,4-D ester + RU Powermax + AMS	1 qt + 22 oz + 2.5 lb	99 a	99 a	99 a	99 a	70 b	99 a
Aim + COC + 28%	1.5 oz + 1 qt + 2%	15 d	20 d	20 e	20 d	20 de	20 d
Sharpen + MSO + AMS	1 oz + 1% + 2.5 lb	20 d	45 c	30 e	30 c	50 c	20 d
2,4-D ester	1 qt	0 e	99 a	99 a	85 b	45 cd	90 a
Banvel	8 oz	10 de	40 c	80 b	30 c	88 a	90 a

RCB: 2 reps
Variety:
Planting Date:
Burndn: 5/5/16 Vetch 8 in; Dali 6-10 in rosette blooming, Rape 15-24 in; Scurf pea 15 in.

Precipitation: (inches)
Burndn: 1st week 1.47 2nd week 0.00

Soil: Silty Clay Loam; 3.4% OM; 6.4 pH

Dali=Dandelion
Whcl=White clover

P=0.05 (numbers in each column followed by the same letter are not significantly different)

Comments: The mild winter allowed some cover crops to survive that normally do not overwinter. This study looked at options to burndown cover crops before spring planting. The higher rate of glyphosate and the glyphosate with 2,4-D treatments were the most consistent across all the cover crops, however other treatments provided excellent control on certain crops.

SOUTHEAST RESEARCH FARM ANNUAL REPORT
South Dakota State University
2016 Progress Report
Agricultural Experiment Station
Plant Science Department
South Dakota State University, Brookings, SD 57007
Southeast Research Farm, Beresford SD 57004

Observations on Soil Temperature and Moisture in Relation to Tillage

Peter Sexton*, Duane Auch,
Sara Berg, and Ruth Stevens.

INTRODUCTION

Tillage impacts residue levels for the following crop. Residue, in turn, influences soil temperature and moisture which are key factors influencing crop growth. This is particularly true for corn since its growing point is below ground up to the V6 growth stage (which generally occurs about 4 to 5 weeks after planting), so its rate of development early in the season is largely governed by soil temperature. With this in mind, soil temperature and moisture sensors were placed in the long-term rotation trial at the Southeast Farm to begin to collect data on how different management systems impact soil temperature.

METHODS

Soil moisture sensors (model Em50 Data Logger with 5 TM Sensors, Decagon Devices, Pullman, WA) were placed at depths of 12" and 24" in three replicates comparing tilled versus no-tilled plots in a corn/soybean rotation. Due to problems with damage to wiring, the data represents only single replicates at some points. Because of the limited replicates for this data, these results should be viewed as preliminary observations. Data on corn and soybean yield from the rotation study is given in other sections of this annual report (SERF AR 1608). We hope to have more complete data in the coming season.

RESULTS AND OBSERVATIONS

The 2016 season was marked by a very wet spring with 4.6" above average rainfall over the months of April and May (Fig. 1). This was followed by below normal rainfall in June and July, but not enough to develop severe drought stress. August was average for rainfall and September again was wet. Plotting rainfall on a cumulative basis, one can see the steep increases in May and September, but overall cumulative moisture was not far from average in August even though June and July were on the dry side (Fig. 2).

Looking at soil moisture, at the 12" depth the partial data we have shows the no-till soybeans (which are on corn stubble) tending towards higher spring moisture than the conventional till and no-till corn plots had (Fig. 3). In these particular plots, the conventional till corn has good moisture and we don't see consistent separation until the lines segregate out in early August, with the no-till corn and beans showing higher moisture through mid to late August until the advent of the September rains. In September, with more rainfall the lines tend to converge again. At the 24" depth (Fig. 4), we

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see that the no-till plots definitely show higher moisture through the spring and into early July and then the lines converge and tend to follow the same path after that. Note there is no data from the tilled soybean plots in the 24" data set as it was limited in nature and not consistent. Looking at soil temperature at the 12 and 24" depths (Fig. 5 and 6, respectively), we see that in the spring all the treatments tended to show similar temperature at these depths. In June as the rain subsided and the crops started to grow there was some separation with the conventional tilled corn tending to be a little warmer than the other plots until mid to late July when soil temperature in the no-till soybean plots tended to catch up with it, and in late August the no-till soybean plots tended to be the plots with the warmest soil temperature.

This season, at the 2" depth in corn, up to July 7 in this study, soil temperature averaged 2 F warmer in the tilled plots than in the no-till plots (Fig 7). In terms of growing degree days, assuming it takes about 35 days to reach V6 when the growth stage comes above ground, a temperature difference of 2 F over this period would be the equivalent of about 70 gdd, or roughly 3 relative maturity days for a corn hybrid. From July 7 to mid-August, the conventional tilled plots averaged 0.7 F warmer soil temperature, after which the temperatures converged (average difference < 0.1 F).

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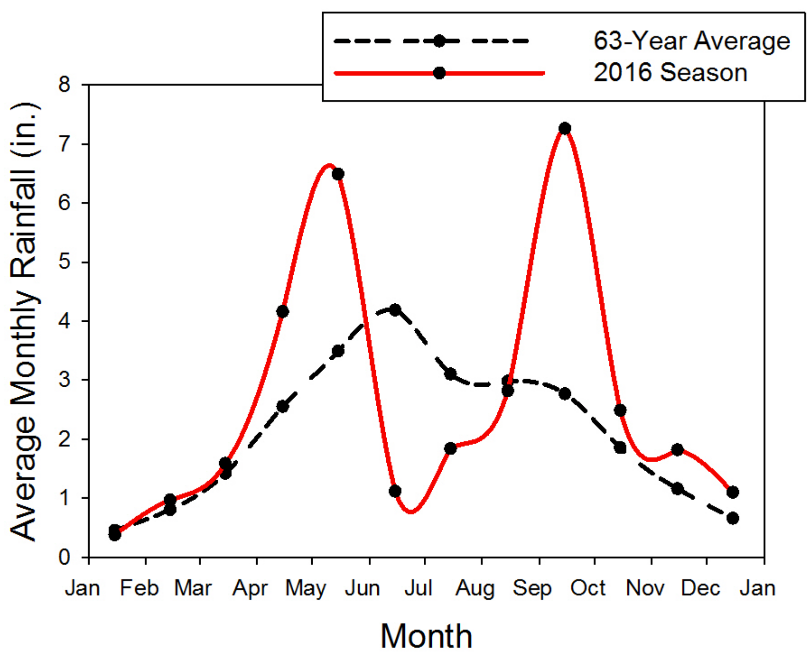

Fig. 1. Monthly rainfall totals for 2016 plotted with average monthly rainfall (63 year average) at the Southeast Research Farm in Beresford, SD. During the months of April and May total rainfall was 4.6" above average, which greatly impacted planting operations in the area.

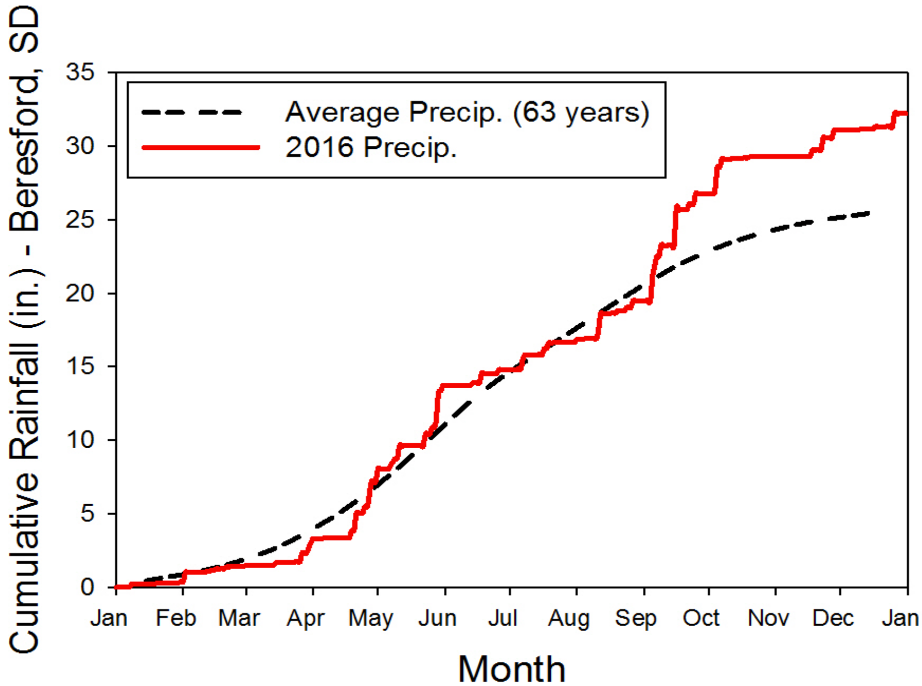

Fig. 2. Cumulative rainfall is 2016 plotted along with average cumulative rainfall over the course of the year. Note the steep increase in rainfall in late April through May and again in September – these correspond with the wet periods as shown in Fig. 1.

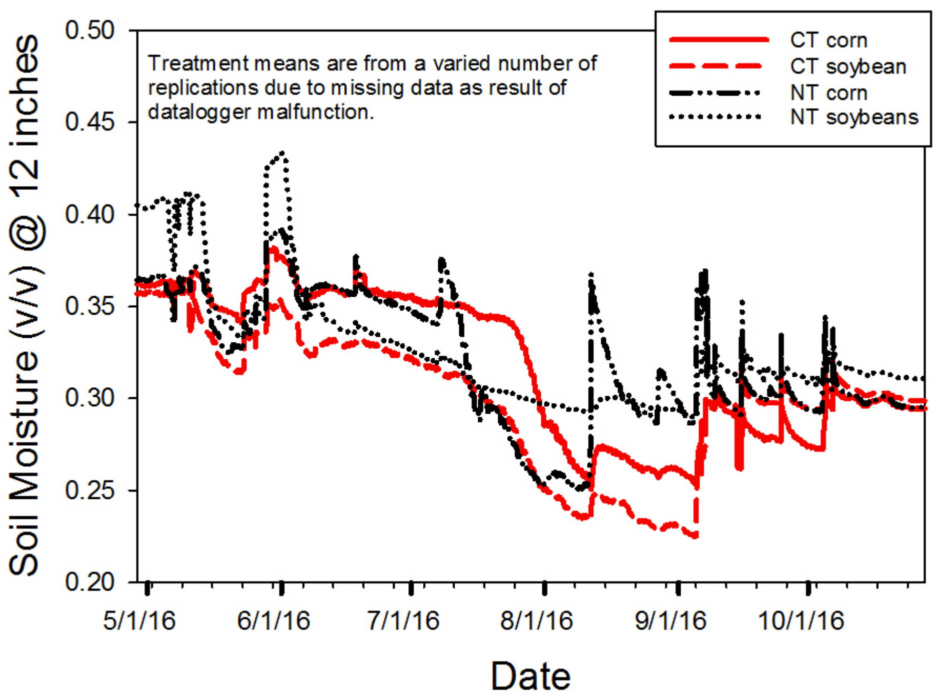

Fig. 3. Volumetric water content at 12” depth over the course of the season for corn and soybeans under tilled and no-till management in a long-term trial at the SDSU Southeast Research Farm in 2016. Due to data logger malfunction, there are limited replications (in some cases only one replication) represented in this data.

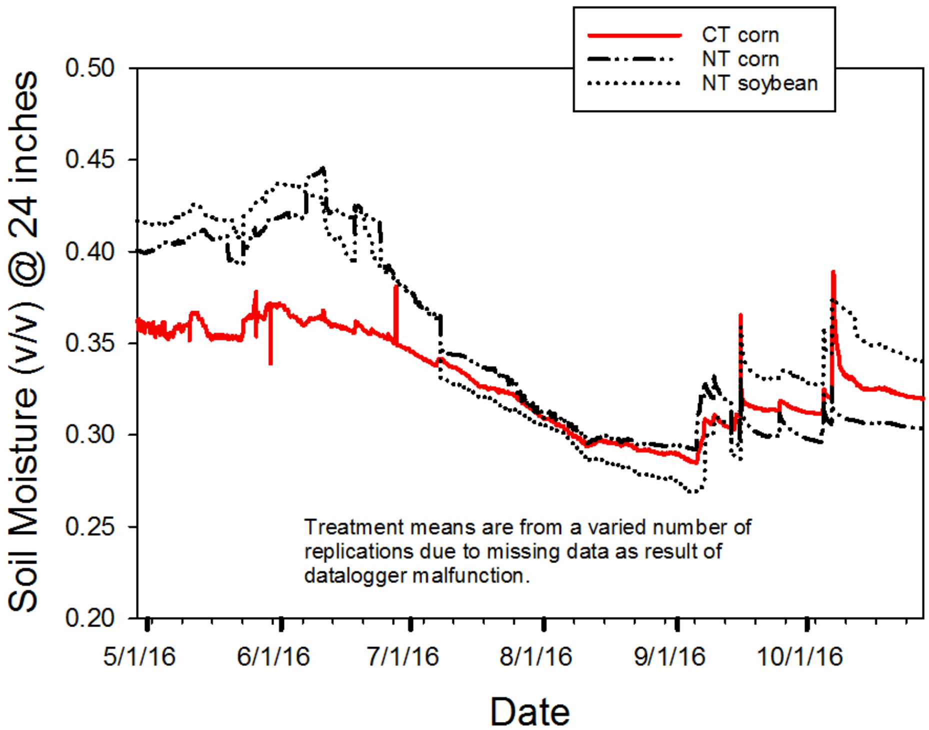

Fig. 4. Volumetric water content at 24” depth over the course of the season for corn and soybeans under tilled and no-till management in a long-term trial at the SDSU Southeast Research Farm in 2016. Due to data logger malfunction, there are limited replications (in some cases only one replication) represented in this data.

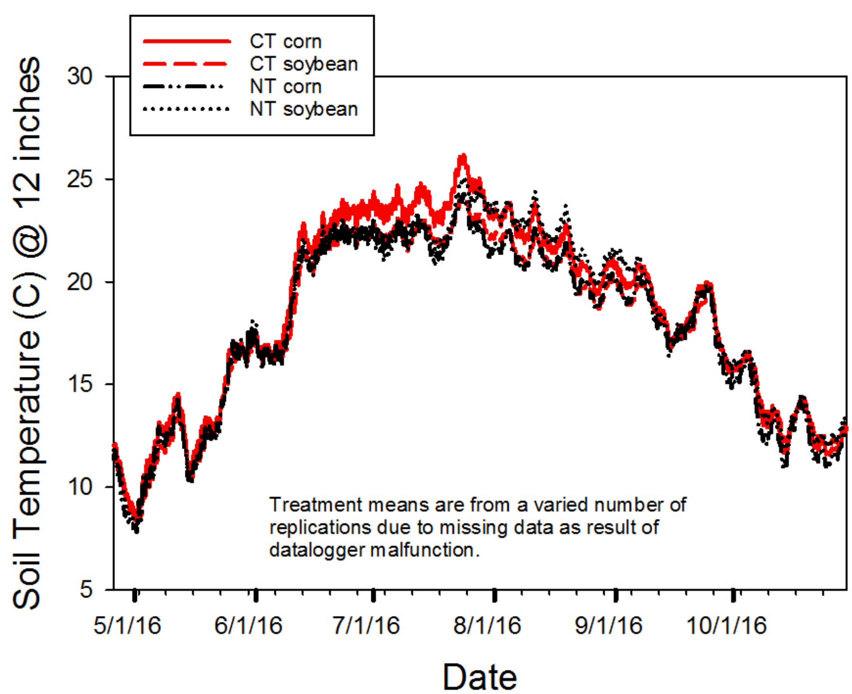

Fig. 5. Soil temperature at 12” depth over the course of the season for corn and soybeans under tilled and no-till management in a long-term trial at the SDSU Southeast Research Farm in 2016. Due to data logger malfunction, there are limited replications (in some cases only one replication) represented in this data.

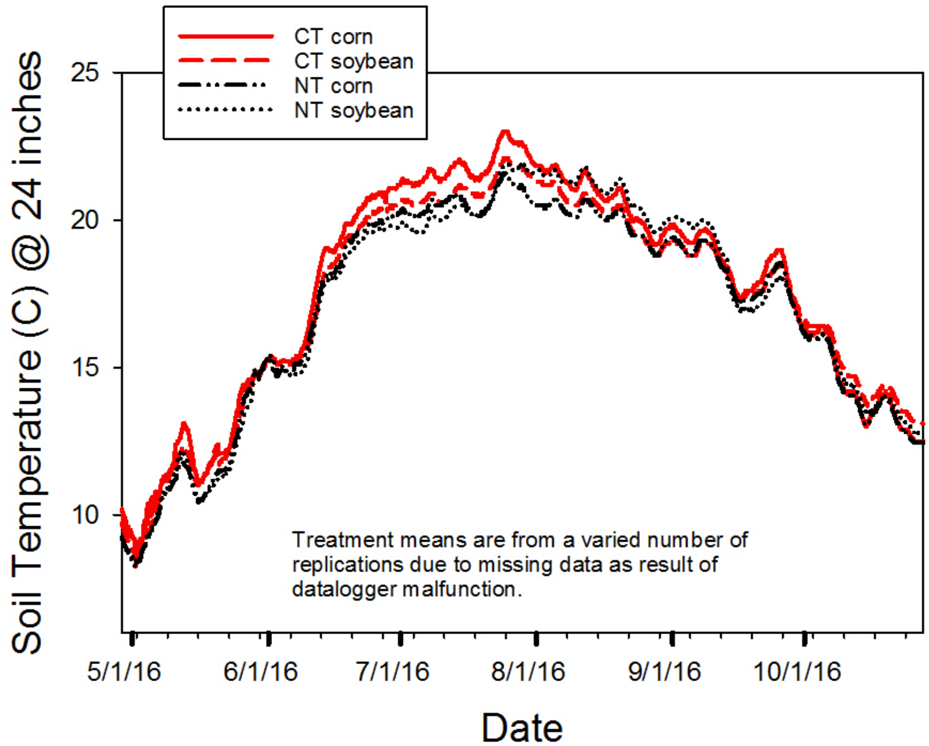

Fig. 6. Soil temperature at 24" depth over the course of the season for corn and soybeans under tilled and no-till management in a long-term trial at the SDSU Southeast Research Farm in 2016. Due to data logger malfunction, there are limited replications (in some cases only one replication) represented in this data.

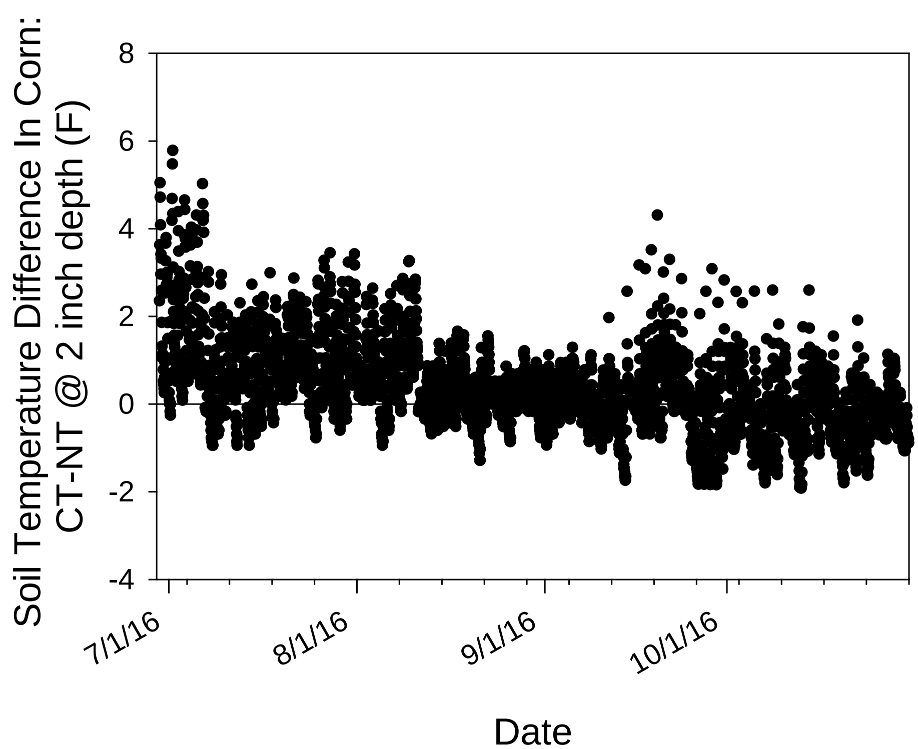

Fig. 7. Difference in soil temperature at a 2" depth between tilled and no-till corn plots in a trial at the SDSU Southeast Research Farm in Beresford, SD. Each point represents differences in hourly measurements from the average of 2 tilled and 2 no-till plots. At some points the tillage system is only represented by one replicate, so this should be viewed as preliminary data.

SOUTHEAST RESEARCH FARM ANNUAL REPORT
South Dakota State University
2016 Progress Report
Agricultural Experiment Station
Plant Science Department
South Dakota State University, Brookings, SD 57007
Southeast Research Farm, Beresford SD 57004

2016 Crop Performance Testing Results for SERF: Corn, Soybean, and Winter Wheat

Jonathan Kleinjan*, Kevin Kirby, and Shawn Hawks

INTRODUCTION

The results of the SDSU Crop Performance Testing (CPT) program are released each year due in part to sponsorship by SDSU Extension and the South Dakota Agricultural Experiment Station. Corn, soybean, winter wheat, and oat variety trials are conducted annually at the Southeast Research Farm location near Beresford, SD. The winter wheat breeding project manages the winter wheat variety trial at this location and the oat breeding project manages the oat variety trial. CPT personnel manage the corn and soybean trials. For more information about the CPT program, please visit their Facebook page: https://www.facebook.com/SDSUExtCropTesting

METHODS

Corn and soybean trials were planted in 30-inch rows with a SRES precision four-row planter. Four-row plots were planted to a length of 20 ft and the center two rows were harvested for grain yield. Small grain variety trials were drilled using John Deere no-till openers set on 8-inch spacing. At harvest, plots were 5 ft wide and 13 ft in length. Additional information about trial management can be found with the trial results.

RESULTS AND DISCUSSION

Results for the corn and soybean trials are included in the following pages and can also be found, along with the small grains trial results, on the igrow website: http://igrow.org/agronomy/profit-tips/variety-trial-results/

The five-year average corn yields for this location are 215 and 216 bu/acre, respectively for the early (≤107 day RM) and late (≥108 day RM) maturity tests. Yields in 2016 were right around average with early and late test averages of 213 and 215 bu/acre, respectively. Soybeans also performed better than the five-year average of 68 bu/acre (Group II), with 2016 yields of 76 bu/acre.

Winter wheat yields were similar in 2016 (66 bu/acre) to the 3-year average of 68 bu/acre. Winter wheat varieties recommended for the 2016 season, based on 3-year averages, Redfield, Freeman, WB-Grainfield, LCS Mint, Lyman, and SY Wolf. The oat performance trial was lost due to flooding.

ACKNOWLEDGEMENTS

The efforts of the following SDSU personnel are greatly appreciated: Oat Breeding Project – M. Caffe-Treml, N. Hall; Winter Wheat Breeding Project – S. Sehgal, S. Kalsbeck.

* *Corresponding author: Jonathan.Kleinjan@sdstate.edu*

2016 South Dakota Corn Hybrid Trial Results Beresford

Jonathan Kleinjan | SDSU Crop Performance Testing Director
Kevin Kirby | Agricultural Research Manager
Shawn Hawks | Agricultural Research Manager

Location:	6 miles west and 3 miles south of Beresford (57432) in Clay county, SD (GPS: N 43°02.783’ W 096°54.125’)
Cooperator:	SDSU Southeast Research Farm - Peter Sexton, manager
Soil Type:	Egan-Clarno-Trent silty complex, 0-2% slope, non-irrigated
Fertilizer:	130-0-0 preplant; 30-10-10 starter
Yield Goal:	200 bu/acre
Previous crop:	Soybeans
Tillage:	Conventional
Row spacing:	30 inches
Seeding Rate:	31,400/acre
Herbicide:	Pre: 32 oz Roundup (glyphosate) + 1.33 pt Dual (metolachlor) + 4 oz Metribuzin (metribuzin) + 1 oz Sharpen (saflufenacil) Post: none
Date seeded:	5/6/2016
Date harvested:	10/26/2016

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2016 South Dakota Corn Hybrid Trial Results Beresford

Table 1. Glyphosate-resistant corn hybrid variety performance results (average of 4 replications) - **Early Season Trial (107 day maturity or less)** at Beresford, SD.

Variety Information			Agronomic Performance				
Brand	Hybrid	Maturity Rating	**Yield Bu/A (15.5%)**	Moisture %	Test Wt. (lbs/bu)	Lodging* %	Final Stand (plants/A)
Channel	207-27STXRIB	107	**234.7**	17.4	59.5	0.0	28900.0
Nutech/G2 Genetics	5F-504	104	**233.9**	16.9	61.1	0.7	28600.0
Nutech/G2 Genetics	5F-906	106	**230.7**	17.6	60.2	0.0	26300.0
Renk	RK776SSTX	107	**229.6**	17.7	60.0	0.7	28000.0
Heine	790VT2PRORIB	107	**228.1**	17.2	59.2	0.7	27600.0
Hoegemeyer	HPT7606AM	106	**226.6**	17.0	60.6	0.0	26300.0
Great Lakes Hybrids	5470STXRIB	104	**224.9**	15.8	58.9	0.4	28600.0
Nutech/G2 Genetics	5H-806	106	**224.7**	17.0	60.3	0.0	27600.0
Hoegemeyer	HPT7557AM	105	**224.5**	17.2	59.8	0.0	26300.0
Nutech/G2 Genetics	5H-905	105	**224.5**	15.7	56.6	0.3	26300.0
Titan Pro	TP 56-06 3110	106	**224.3**	16.4	58.1	0.0	28200.0
Heine	775STXRIB	107	**223.8**	16.2	59.7	0.0	28200.0
Wensman	W91051STXRIB	105	**223.0**	16.6	59.2	0.0	26700.0
Great Lakes Hybrids	5755STXRIB	107	**222.4**	16.4	60.5	1.1	28000.0
Dyna-Gro Seed	D44VC36RIB	104	**222.1**	17.4	59.6	0.0	27500.0
Great Lakes Hybrids	5029VT2RIB	100	**220.5**	15.9	58.5	0.3	28600.0
Heine	791VT2PRORIB	107	**219.7**	17.9	59.0	1.4	27900.0
Thunder Seed	EXP 6803 VT2P	103	**219.5**	17.7	59.2	0.0	26300.0
Heine	744VT3PRORIB	104	213.5	16.3	59.1	0.3	25500.0
Hoegemeyer	HPT7644AM	106	211.7	16.6	59.6	0.0	26600.0
Heine	755VT2PRO	105	210.8	16.3	58.6	1.1	26700.0
Wensman	W9325STXRIB	102	209.4	15.9	58.7	0.3	27800.0
Masters Choice	MCT 5663	106	209.2	17.5	57.1	0.8	24300.0
Thunder Seed	EXP 7805 SS	105	208.9	15.9	58.9	0.0	27900.0
Wensman	W91073STXRIB	107	207.3	17.2	57.9	0.0	22700.0
Great Lakes Hybrids	4548STXRIB	95	203.9	15.2	60.5	0.0	27600.0
Thunder Seed	7603 SS	103	203.7	15.3	58.4	0.3	28100.0
Masters Choice	MCT 5371	103	201.3	16.1	58.2	0.4	24000.0
Check	Check	99	198.5	15.1	56.4	0.0	25800.0
Masters Choice	MCT 5454	104	198.2	16.3	59.1	1.9	26700.0
Great Lakes Hybrids	4879STXRIB	98	196.2	15.4	58.0	0.0	27600.0
Great Lakes Hybrids	5283STXRIB	102	196.0	15.9	58.0	0.0	27400.0
Stine	9538-20	104	188.3	17.4	60.0	0.8	23000.0
Stine	9529E-20	105	184.9	18.7	60.1	0.0	23100.0
		Trial Average	213.2	16.6	59.2	0.4	26800.0
		LSD (0.05)†	16.2	0.7	1.1	1.1	1100.0
		C.V.‡	5.4	2.7	1.3	-	2.9

* Lodging percentage - stalks broken below the ear as a percentage of the final stand.

† Yield or moisture value required (≥LSD) to determine if varieties are significantly different from one another.

‡ C.V. is a measure of variability or experimental error, 15% or less is acceptable.

2016 South Dakota Corn Hybrid Trial Results Beresford

Table 2. Glyphosate-resistant corn hybrid variety performance results (average of 4 replications) - Late **Season Tria**l **(108 day maturity or more)** at Beresford, SD.

Variety Information			Agronomic Performance				
Brand	Hybrid	Maturity Rating	**Yield Bu/A (15.5%)**	Moisture %	Test Wt. (lbs/bu)	Lodging* %	Final Stand (plants/A)
Nutech/G2 Genetics	5F-308	108	**240.8**	19.8	59.9	0.0	27000
Hoegemeyer	HPT8066AM	110	**236.5**	19.3	60.0	0.0	28000
Channel	209-53STXRIB	109	**230.3**	20.2	59.7	0.4	28200
Heine Seeds	834DGVT2PRO	112	**229.9**	19.9	59.1	0.0	27200
Dyna-Gro Seed	D52SS91RIB	112	**227.7**	22.0	59.1	0.4	26800
Nutech/G2 Genetics	5F-510	110	**226.7**	19.9	60.4	0.0	27200
Renk	RK877DGVT2P	111	225.8	21.7	58.9	0.0	24800
Great Lakes Hybrids	6185STXRIB	111	224.5	18.7	59.1	0.0	26900
Titan Pro	TP 66-10 2P	110	223.9	19.3	58.7	0.0	24700
Renk	RK871VT2P	111	223.7	21.2	59.0	0.0	23800
Nutech/G2 Genetics	5F-709	109	222.3	19.9	58.3	0.4	25300
Titan Pro	TP 59-08 SS	108	222.2	17.9	59.7	0.0	25600
Great Lakes Hybrids	6462STXRIB	114	218.0	21.7	60.3	0.4	26600
Renk	RK810SSTX	110	217.3	19.5	58.9	0.4	28400
Channel	209-44VT2PRIB	109	216.5	19.4	58.4	0.4	25200
Great Lakes Hybrids	5824STXRIB	108	215.1	18.5	61.2	0.4	25900
Dyna-Gro Seed	D49VC39RIB	109	215.1	19.4	59.8	0.0	25000
Titan Pro	TP 55-11 2P	111	212.9	20.2	58.9	0.0	25000
Wensman	W91095STXRIB	109	203.5	18.5	60.5	0.0	27000
Channel	211-35STXRIB	111	202.6	21.8	59.9	0.4	26600
Renk	RK792SSTX	108	198.7	18.0	59.2	0.0	25200
Great Lakes Hybrids	5944STXRIB	109	193.9	19.3	58.2	0.0	21500
Check	Check	99	189.9	15.4	58.6	0.0	25800
Wensman	W91112STXRIB	111	189.8	19.3	59.6	0.0	21500
		Trial Average	215.1	19.3	59.3	0.1	25900
		LSD (0.05)†	14.6	0.8	0.8	0.6	919
		C.V.‡	4.8	2.9	1.0	-	2.5

* Lodging percentage - stalks broken below the ear as a percentage of the final stand.

† Yield or moisture value required (≥LSD) to determine if varieties are significantly different from one another.

‡ C.V. is a measure of variability or experimental error, 15% or less is acceptable.

2016 South Dakota Soybean Variety Trial Results - Beresford

Jonathan Kleinjan | SDSU Crop Performance Testing Director
Kevin Kirby | Agricultural Research Manager
Shawn Hawks | Agricultural Research Manager

Location:	6 miles west and 3 miles south of Beresford (57432) in Clay county, SD (GPS: 43.046386, -96.902161)
Cooperator:	SDSU Southeast Research Farm - Peter Sexton, manager
Soil Type:	Egan-Clarno-Trent silty clay loam, 0-2% slope, non-irrigated
Fertilizer:	None
Previous crop:	Corn
Tillage:	No-till
Row spacing:	30 inches
Seeding Rate:	165,000/acre
Herbicide:	Pre: 32 oz Roundup Power Max (glyphosate) + 1.33 pt Dual (metolachlor) + 4 oz Glory (metribuzen) + 1 oz Sharpen (saflufenacil) Post: 0.3 oz FirstRate (cloransulam) + 12 oz Flexstar (fomesafen) + 6 oz Select (clethodim)
Insecticide:	None
Date seeded:	5/20/2016
Date harvested:	10/24/2016

2016 South Dakota Soybean Variety Trial Results - Beresford

Table 1. Glyphosate-resistant soybean variety performance results (average of 4 replications) - Maturity Group 1 at Beresford, SD).					
Variety Information			Agronomic Performance		
Brand	Variety	Maturity Rating	**Yield (bu/ac@13%)**	Moisture %	Lodging Score (1-5)*
Great Lakes Hybrids	GL1953NR2	1.9	**81.8**	12.9	1.0
Channel	1808R2	1.8	**78.1**	13.0	1.0
Thunder Seed	3614 R2YN	1.4	77.1	13.2	1.0
Thunder Seed	3619 R2YN	1.9	76.7	12.8	1.0
Thunder Seed	3511 R2YN	1.1	75.8	13.2	1.0
Thunder Seed	EXP 8713N	1.3	71.4	13.2	1.0
Great Lakes Hybrids	GL1760NRX	1.7	71.4	13.0	1.0
Check	Check	1.4	71.2	13.3	1.0
Thunder Seed	EXP 8710N	1.0	68.3	13.2	1.0
Thunder Seed	EXP 8718N	1.8	67.6	12.8	1.0
		Trial Average	73.9	13.0	1.0
		LSD (0.05)†	4.1	0.2	-
		C.V.‡	3.8	1.0	-

* Lodging Score (1 = no lodging to 5 = flat on the ground)

† Yield or moisture value required (≥LSD) to determine if varieties are significantly different from one another. Yield values statistically similar to the overall trial winner are shown in **boldface**.

‡ C.V. is a measure of variability or experimental error, 15% or less is acceptable.

Table 2a. Glyphosate-resistant soybean variety performance results (average of 4 replications) - Maturity Group 2 at Beresford, SD).

Variety Information			Agronomic Performance		
Brand	Variety	Maturity Rating	**Yield (bu/ac@13%)**	Moisture %	Lodging Score (1-5)*
Stine	24RH62	2.4	**84.1**	12.6	1.0
Great Lakes Hybrids	GL2469R2	2.4	**82.2**	12.8	1.0
Stine	28RH02	2.8	**81.8**	12.7	1.0
Dyna-Gro Seed	S23RY85	2.3	**81.3**	12.6	1.0
Prairie Brand	PB-2876R2	2.8	**81.3**	12.5	1.0
Prairie Brand	PB-2600R2	2.6	**80.6**	12.4	1.0
Prairie Brand	PB-2419RR2	2.4	**80.3**	12.2	1.0
Wensman	W3228NR2	2.2	**79.7**	12.3	1.0
Wensman	W1208NRX	2.0	79.3	12.3	1.0
Wensman	W3226NR2	2.2	79.1	12.7	1.0
Great Lakes Hybrids	GL2063NRX	2.0	78.5	12.4	1.0
Prairie Brand	PB-3087R2	2.9	78.2	12.4	1.0
NuTech	7279	2.7	78.2	12.5	1.0
Dairyland Seed	DSR-2330/R2Y	2.3	77.7	12.8	1.0
Dairyland Seed	DSR-2616/R2Y	2.6	77.3	12.3	1.0
Titan Pro	TP-24R26	2.4	77.2	12.7	1.0
Dyna-Gro Seed	S26RS75	2.6	77.0	12.9	1.0
Prairie Brand	PB-2486R2	2.4	76.6	12.7	1.0
Titan Pro	TP-28X45	2.8	76.5	12.5	1.0
Prairie Brand	PB-2576R2	2.5	76.1	12.7	1.0
Wensman	W3201NR2	2.0	76.0	13.2	1.0
Wensman	W1233RX	2.3	75.7	12.3	1.0
Channel	2607R2	2.6	74.9	12.6	1.0
Channel	2306R2	2.3	74.9	12.3	1.0
Prairie Brand	PB-2296R2	2.2	74.8	12.4	1.0
Dyna-Gro Seed	S20RY45	2.0	74.6	12.8	1.0
Prairie Brand	PB-2788R2	2.7	74.5	12.4	1.0
Prairie Brand	PB-2156R2	2.1	74.3	12.8	1.0
Great Lakes Hybrids	GL2269NR2	2.2	74.3	12.4	1.0
Wensman	W1255NRX	2.5	73.3	12.4	1.0
		Trial Average	75.9	12.6	1.0
		LSD (0.05)†	4.6	0.4	-
		C.V.‡	4.3	2.1	-

* Lodging Score (1 = no lodging to 5 = flat on the ground)

† Yield or moisture value required (≥LSD) to determine if varieties are significantly different from one another. Yield values statistically similar to the overall trial winner are shown in **boldface**.

‡ C.V. is a measure of variability or experimental error, 15% or less is acceptable.

Table 2b. Glyphosate-resistant soybean variety performance results, continued (average of 4 replications) - Maturity Group 2 at Beresford, SD).					
Variety Information			Agronomic Performance		
Brand	Variety	Maturity Rating	**Yield (bu/ac@13%)**	Moisture %	Lodging Score (1-5)*
Great Lakes Hybrids	GL2465NRX	2.4	72.9	12.4	1.0
Check	Check	1.4	70.7	12.9	1.0
Prairie Brand	PB-2024R2	2.0	70.2	12.6	1.0
NuTech	7217R2	2.1	69.7	12.9	1.0
NuTech	7224	2.2	68.8	12.9	1.0
Titan Pro	22M12	2.2	68.6	12.8	1.0
Stine	29RE22	2.9	63.4	12.3	1.0
		Trial Average	75.9	12.6	1.0
		LSD (0.05)†	4.6	0.4	-
		C.V.‡	4.3	2.1	-

* Lodging Score (1 = no lodging to 5 = flat on the ground)

† Yield or moisture value required (≥LSD) to determine if varieties are significantly different from one another. Yield values statistically similar to the overall trial winner are shown in **boldface**.

‡ C.V. is a measure of variability or experimental error, 15% or less is acceptable.

2016 South Dakota
Spring Wheat Variety Trial Results

Jonathan Kleinjan | SDSU Extension Crop Performance Testing (CPT) Director
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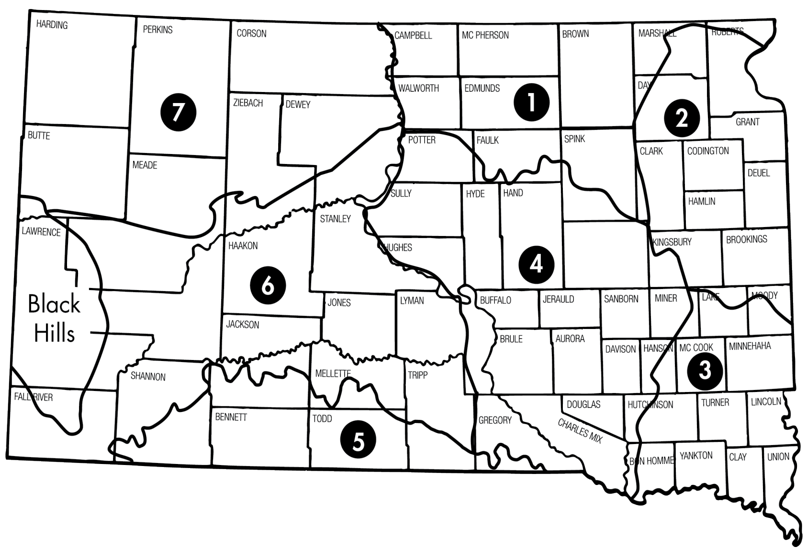
Kevin Kirby | Ag Research Manager, Brookings
Bruce Swan | Ag Research Manager, Rapid City
Shawn Hawks |Ag Research Manager, Brookings



Recommended/Promising Spring Wheat Varieties for Spring 2017 by Crop Zone†

Zone - 1	Zone - 2	Zone - 3	Zone - 4	Zone - 5	Zone - 6	Zone - 7
Advance	Focus	Not Evaluated§	Advance	Not Evaluated§	Prevail	Not Evaluated§
Surpass	Forefront		MS Chevelle‡		Surpass	
MS Chevelle‡	Prevail		Faller‡		MS Chevelle‡	
Faller‡	Surpass		HRS 3419‡		Faller‡	
HRS 3504‡	Faller‡		HRS 3504‡		Prosper‡	
Prosper‡	HRS 3419‡		Prosper‡		RB07‡	
RB07‡	HRS 3504‡		WB9507		WB9507	

Promising

Zone - 1	Zone - 2	Zone - 3	Zone - 4	Zone - 5	Zone - 6	Zone - 7
HRS 3530‡	MS Chevelle‡	Not Evaluated§	No data	Not Evaluated§	HRS 3530‡	Not Evaluated§
SY Rustler‡	SY Rustler‡				LCS Trigger‡	
LCS Trigger‡	LCS Trigger‡				SY Rustler‡	
SY Valda	SY Valda				SY Valda	
WB9653	WB9653					

† Crop Zones for small grains are base on soil & climate information. Recommended varieties are in the top 1/3 or the trial over 3 years for each zone. Promising varieties are those in the top 1/3 of the trial over 2 years.

‡ Variety is susceptible or moderately susceptible to Fusarium Head Blight (Scab).

§ Varieties are not evaluated in this zone, however it is suggested to select a variety that appears frequently in the recommended list across all zones for the state or neighboring zones.

South Dakota State University, South Dakota counties, and USDA cooperating.
South Dakota State University adheres to AA/EEO guidelines in offering educational programs and services.

Table 1. List of 2016 spring wheat testing locations and soil/cultural characteristics.

Location	Testing location characteristics				
	Cooperator	GPS coordinates	Soil Type	Previous crop	Tillage system
East River Locations (7)					
Aberdeen	Locken Farms	45.496228 -98.558762	Barnes-Cresbard-Tonka complex, 0-3% slopes	Soybeans	No-till
Agar	Cronin Farms	44.943287 -100.123192	Eakin silt loam, 0-2% slopes	Field peas	No-till
Faulkton	Ryan Melius	45.084244 -99.083927	Williams-Bowbells loams, 0-3% slopes	Soybeans	No-till
Miller	Nathan Lichty	44.494365 -98.863085	Houdek-Prosper loams, 0-2% slopes	Soybeans	No-till
Selby	Tom Fidelar	45.492563 -100.011125	Mobridge silt loam, cool, 0-2% slopes	Soybeans	No-till
South Shore	NERF	45.106979 -97.097062	Kranzburg-Brookings silty clay loams, 0-2% slopes	Soybeans	Conv. Till
Volga	Volga Research Farm	44.302372 -96.920463	Brandt silty clay loam, 0-2% slopes	Soybeans	No-till
West River Locations (3)					
Bison	Brad Seidel	45.529722 -102.401111	Felor-Yegen loams, 2-6% slopes	Spring Wheat	No-till
Draper	Paul Patterson	43.860556 -100.529722	Bullcreek clay, 0-6% slopes	Milo	No-till
Wall	Merritt Patterson & Sons	44.095833 -102.338056	Satanta loam, 1-2% slopes	Chem Fallow	No-till

Table 2. Agronomic practices for 2016 spring wheat trial locations.

Location	Agronomic practices					
	Planting date	Starter applied	Other Fertilizer applied	Herbicide applied	Fungicide applied	Harvest date
East River Locations (7)						
Aberdeen	04/04/16	90# 30-10-10	132-0-40-20S	1.5 pt Maestro MA	None	8/2/16
Agar	03/29/16	90# 30-10-10	100-0-0 pp	1.5 pt Maestro MA	None	8/3/16
Faulkton	04/08/16	90# 30-10-10	105-0-0 fall NH_3	1.5 pt Maestro MA	None	8/3/16
Miller	04/04/16	90# 30-10-10	100-0-0-36S pp	1.5 pt Maestro MA	None	7/28/16
Selby	04/06/16	90# 30-10-10	172-52-0 pp	1.5 pt Maestro + 1 pt Axial XL	15 oz Carumba (flowering)	8/8/16
South Shore	04/13/16	90# 30-10-10	165-0-0 pp	1 pt Brox M Ultra	None	7/26/16
Volga	04/05/16	90# 30-10-10	100-30-30 pp	1.5 pt Maestro MA	None	8/5/16
West River Locations (3)						
Bison	4/13/16	6 gal 10-25-0-5-.5	80 lbs N/Acre as 28-0-0	1.3 pt Widematch + 12 oz MCPA ester	none	NA‡
Draper	04/04/16	6 gal 10-25-0-5-.5	125 lbs N/Acre as 28-0-0	1 pt Widematch (5/28/16)	none	8/3/16
Wall	03/29/16	6 gal 10-25-0-5-.5	125 lbs N/Acre as 28-0-0	16 oz Roundup Power Max (fall applied)	none	8/2/16

‡ Plots at Bison were abandoned due to damage caused by chemical drift.

Table 3a. 2016 East River Spring Wheat Performance - Yield (13% M), Test Weight (harvest M), and Protein (12% M). Varieties yielding in the upper 1/3 of each trial location are denoted by gray shading.

Variety	Crop Zone - 1									Crop Zone - 2		
	Aberdeen			Faulkton			Selby			South Shore		
	Yield	Test Wt	Protein	Yield	Test Wt	Protein	Yield	Test Wt	Protein	Yield	Test Wt	Protein
Advance	54.2	58.1	15.5	59.3	56.5	13.4	89.8	60.6	14.0	41.3	56.2	17.0
LCS Anchor†	58.0	58.6	16.0	56.7	54.7	14.3	89.5	61.9	14.5	42.8	55.7	17.5
Bolles	47.8	56.7	16.6	56.2	55.1	14.2	86.1	61.1	16.4	36.0	54.8	19.3
Boost	52.9	54.9	16.3	59.3	55.3	13.9	81.9	58.8	15.0	36.9	55.4	17.7
Brick	54.3	59.5	15.5	56.0	58.5	13.1	89.1	60.5	14.3	39.7	55.3	16.4
MS Chevelle	54.8	59.9	15.3	68.0	55.5	12.7	96.8	59.3	13.8	42.8	55.9	16.9
Elgin-ND	54.4	55.3	15.6	60.6	55.4	13.7	86.3	58.9	15.0	39.1	54.5	17.4
Faller	53.7	54.1	14.9	58.3	54.8	13.1	92.8	59.8	14.2	37.4	52.0	16.7
Focus	54.9	57.9	16.1	63.8	58.4	13.7	84.3	60.3	14.9	42.1	57.1	16.9
Forefront	51.5	57.9	15.4	63.4	57.2	14.1	85.2	59.8	14.2	43.8	56.6	16.2
HRS 3100†	56.5	57.6	14.7	68.9	55.6	13.6	91.9	59.7	14.6	38.5	54.5	17.2
HRS 3361	55.6	55.2	15.8	64.3	54.9	12.9	87.9	58.8	14.6	35.7	54.0	17.0
HRS 3419	52.1	54.3	14.7	69.1	55.9	12.4	96.9	59.7	13.9	36.3	53.0	18.0
HRS 3504	52.7	56.9	14.7	72.0	56.6	13.3	95.1	59.4	14.6	38.1	56.2	17.4
HRS 3530	51.4	57.7	15.8	63.4	57.0	14.4	97.5	60.3	14.5	39.9	52.8	17.7
HRS 3616†	57.1	58.1	15.9	61.8	54.7	13.8	87.8	58.9	14.6	39.6	55.0	16.9
SY Ingmar†	59.2	59.1	15.9	66.7	57.2	13.7	94.6	61.6	14.0	42.3	53.6	17.6
Linkert	55.1	57.3	15.9	63.9	57.3	15.1	90.6	60.0	14.5	39.0	56.8	18.1
Prevail	54.9	59.1	15.0	65.0	58.1	13.1	88.5	60.2	14.3	45.1	55.6	16.2
Prosper	52.6	57.7	15.7	64.8	56.0	13.0	91.0	57.8	13.8	38.1	52.1	17.1
RB07	50.3	58.7	15.0	64.4	56.4	13.7	94.8	60.5	14.2	40.6	55.2	17.3
SY Rustler	50.8	58.3	15.2	66.6	55.2	13.3	95.0	59.0	14.2	43.3	53.2	17.3
Select	56.1	58.8	15.1	60.2	58.9	14.0	91.1	62.6	13.8	43.2	55.9	16.9
Shelly†	55.3	56.6	14.3	61.5	56.0	13.8	93.4	60.6	14.0	42.5	55.7	16.7
Surpass	54.1	58.7	15.8	68.1	57.6	13.8	93.8	60.3	14.9	43.2	54.4	17.6
LCS Trigger	53.4	58.1	15.2	72.3	56.3	12.7	95.8	60.4	12.7	45.1	54.2	16.2
SY Valda	55.8	57.8	15.8	65.2	56.4	13.6	95.7	59.8	14.0	40.5	53.3	17.5
WB9312†	52.3	57.6	15.7	60.9	56.5	13.9	94.2	59.7	13.0	44.2	56.1	16.8
WB9507	53.2	56.7	15.6	56.0	53.3	12.7	94.0	60.0	14.7	36.1	52.5	17.7
WB9653	58.4	58.1	15.9	68.9	56.0	13.7	97.4	60.4	13.6	40.0	53.5	17.5
Trial Average	53.9	57.8	15.5	63.0	56.4	13.7	89	60.1	14.4	40.4	54.9	17.2
LSD(0.05)‡	3.6	1.8	1.0	7.1	1.1	1.3	4.3	1.1	1.2	3.7	1.2	0.8
CV(%)¶	4.8	2.2	4.8	8.1	1.4	6.8	3.5	1.3	6.2	6.4	1.6	3.3

† New entry in 2016, not previously tested.

‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, ¶ Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

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Table 3b. 2016 East River Spring Wheat Performance, cont. - Yield (13% M), Test Weight (harvest M), and Protein (12% M). Varieties yielding in the upper 1/3 of each trial location are denoted by gray shading.

Variety	Crop Zone - 2			Crop Zone - 4						Crop Zones 1,2, & 4		
	Volga			Agar			Miller			East River		
	Yield	Test Wt	Protein	Yield	Test Wt	Protein	Yield	Test Wt	Protein	Yield	Test Wt	Protein
Advance	70.7	58.6	14.2	62.0	55.9	14.8	52.5	56.0	14.0	61.4	57.4	14.7
LCS Anchor†	69.9	58.9	15.7	59.1	55.8	16.0	55.1	56.9	14.9	61.6	57.5	15.5
Bolles	71.9	56.7	14.4	57.5	53.0	16.4	45.8	56.2	15.0	57.3	56.2	16.0
Boost	69.9	57.9	14.7	56.3	54.6	14.9	50.7	57.2	14.0	58.3	56.3	15.2
Brick	72.2	60.1	14.1	60.9	57.6	15.6	48.3	58.9	14.3	60.1	58.6	14.7
MS Chevelle	77.1	59.4	13.5	67.6	56.1	14.9	57.5	55.8	13.2	66.4	57.4	14.3
Elgin-ND	71.2	57.1	14.4	62.2	55.4	15.5	53.0	57.7	14.3	60.9	56.3	15.1
Faller	73.8	56.3	13.8	58.0	53.0	14.8	49.6	53.4	13.4	60.5	54.8	14.4
Focus	75.1	59.3	15.5	61.6	58.2	15.4	46.4	59.5	14.7	61.2	58.7	15.3
Forefront	71.9	59.3	15.4	55.3	54.6	14.9	43.1	57.5	14.1	59.2	57.6	14.9
HRS 3100†	74.9	59.4	14.4	63.0	53.6	15.2	53.1	56.0	14.1	63.8	56.6	14.8
HRS 3361	70.7	59.1	14.2	57.3	52.8	15.7	46.9	55.0	14.1	59.8	55.7	14.9
HRS 3419	80.5	60.3	13.2	60.7	53.2	14.8	50.9	56.2	14.6	63.8	56.1	14.5
HRS 3504	79.8	59.6	14.4	69.0	54.9	14.9	56.0	58.9	13.3	66.1	57.5	14.6
HRS 3530	76.3	59.6	14.2	62.0	55.6	15.6	50.3	55.2	14.8	63.0	56.9	15.3
HRS 3616†	70.9	57.9	13.9	55.8	54.5	15.3	49.8	57.3	14.5	60.4	56.6	15.0
SY Ingmar†	76.8	60.3	13.5	64.3	56.2	15.5	49.8	55.0	14.3	64.8	57.6	14.9
Linkert	65.5	57.6	15.1	61.4	55.4	15.6	48.6	57.0	14.5	60.6	57.3	15.5
Prevail	82.0	59.7	14.1	61.2	56.6	15.1	50.6	57.4	13.9	63.9	58.1	14.5
Prosper	75.1	58.6	14.7	60.5	53.6	15.3	50.3	56.6	14.3	61.8	56.0	14.8
RB07	71.9	58.7	14.5	62.6	54.4	16.1	47.1	57.5	14.5	61.7	57.3	15.0
SY Rustler	83.0	60.2	13.9	64.2	55.4	15.2	54.7	56.6	14.5	65.4	56.8	14.8
Select	78.8	61.9	14.4	62.5	58.7	14.0	49.6	57.1	13.9	63.1	59.1	14.6
Shelly†	78.8	59.3	14.5	63.9	56.1	14.8	53.9	57.5	13.5	64.2	57.4	14.5
Surpass	78.2	58.2	14.5	66.7	55.8	15.4	52.1	54.8	14.0	65.2	57.1	15.1
LCS Trigger	83.8	59.2	13.5	66.5	55.2	14.5	52.6	56.4	14.2	67.1	57.1	14.1
SY Valda	81.3	59.3	13.8	68.4	54.8	14.7	57.1	56.0	13.5	66.3	56.8	14.7
WB9312†	75.5	58.9	13.1	57.0	55.1	14.1	52.9	58.1	13.8	62.4	57.4	14.3
WB9507	60.7	55.8	14.5	56.5	52.2	15.3	51.6	54.2	13.9	58.3	55.0	14.9
WB9653	82.6	59.2	14.1	66.5	55.8	15.6	58.8	56.4	13.9	67.5	57.0	14.9
Trial Average	74.1	59.0	14.3	61.4	55.6	15.3	50.4	56.5	14.2	61.7	57.2	15.0
LSD(0.05)‡	5.0	1.6	1.6	3.3	1.6	1.0	3.6	2.0	0.9	1.7	0.6	0.4
CV(%)¶	4.9	1.9	8.2	3.9	2.1	4.9	5.0	2.5	4.6	5.3	1.9	5.6

† New entry in 2016, not previously tested.

‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, ¶ Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

Table 4. 2016 East River Spring Wheat Performance, sorted by yield (13% M).

Variety	Crop Zones 1, 2, & 4					
	East River Average					
	Yield	Top 1/3 %*	Test Wt	Protein	Revenue/acre††	Revenue Rank
WB9653	67.5	86	57.0	14.9	$331.21	3
LCS Trigger	67.1	86	57.1	14.1	$284.99	27
MS Chevelle	66.4	86	57.4	14.3	$292.74	20
SY Valda	66.3	86	56.8	14.7	$313.76	9
HRS 3504	66.1	71	57.5	14.6	$312.95	10
SY Rustler	65.4	86	56.8	14.8	$309.55	12
Surpass	65.2	86	57.1	15.1	$329.70	4
SY Ingmar†	64.8	86	57.6	14.9	$317.93	8
Shelly†	64.2	86	57.4	14.5	$293.59	18
Prevail	63.9	57	58.1	14.5	$292.15	21
HRS 3100†	63.8	71	56.6	14.8	$302.26	16
HRS 3419	63.8	43	56.1	14.5	$291.67	22
Select	63.1	43	59.1	14.6	$288.49	25
HRS 3530	63.0	29	56.9	15.3	$328.84	5
WB9312†	62.4	57	57.4	14.3	$275.47	30
Prosper	61.8	0	56.0	14.8	$303.02	15
RB07	61.7	14	57.3	15.0	$312.00	11
LCS Anchor†	61.6	43	57.5	15.5	$331.54	2
Advance	61.4	14	57.4	14.7	$290.79	23
Focus	61.2	29	58.7	15.3	$319.40	7
Elgin-ND	60.9	14	56.3	15.1	$308.35	13
Linkert	60.6	14	57.3	15.5	$326.10	6
Faller	60.5	14	54.8	14.4	$276.71	29
HRS 3616†	60.4	14	56.6	15.0	$296.36	17
Brick	60.1	0	58.6	14.7	$284.45	28
HRS 3361	59.8	14	55.7	14.9	$293.19	19
Forefront	59.2	14	57.6	14.9	$290.21	24
WB9507	58.3	14	55.0	14.9	$285.95	26
Boost	58.3	0	56.3	15.2	$304.29	14
Bolles	57.3	0	56.2	16.0	$336.37	1
Trial Average	61.7	-	57.2	15.0	$304.13	-
LSD(0.05)‡	1.7	-	0.6	0.4	-	-
CV(%)¶	5.3	-	1.9	5.6	-	-

† New entry in 2016, not previously tested. ‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, ¶ Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

*Top 1/3% is the percentage of time a variety yields in the top 1/3 of a location (includes some experimental lines not reported). ††Revenue is based on a cash price of $4.25/bu and a 10 year average Minneapolis grain exchange protein premium/discount schedule.

Table 5. 2016 West River Spring Wheat Performance - Yield (13% M), Test Weight (harvest M), and Protein (12% M). Varieties yielding in the upper 1/3 of each trial location are denoted by gray shading.

Variety	Crop Zone - 6						Crop Zone - 6		
	Draper			Wall			West River		
	Yield	Test Wt	Protein	Yield	Test Wt	Protein	Yield	Test Wt	Protein
Advance	43.4	55.7	15.3	35.6	54.2	14.2	39.5	55.0	14.7
LCS Anchor†	39.9	57.7	16.8	45.8	57.7	14.8	42.8	57.7	15.8
Bolles	37.8	56.6	18.5	27.8	53.8	15.7	32.8	55.2	17.1
Boost	35.6	56.2	15.8	33.3	53.3	14.3	34.4	54.7	15.1
Brick	41.4	58.6	15.1	39.2	56.9	13.9	40.3	57.8	14.5
MS Chevelle	42.9	56.5	14.5	37.2	54.0	13.4	40.0	55.2	14.0
Elgin-ND	39.4	55.7	16.0	39.2	55.5	14.3	39.3	55.6	15.1
Faller	38.1	53.8	15.4	40.4	52.9	13.3	39.3	53.3	14.4
Focus	37.6	59.1	16.9	41.2	58.4	14.4	39.4	58.7	15.6
Forefront	29.5	58.1	15.5	35.9	56.4	14.1	32.7	57.3	14.8
HRS 3100†	41.8	54.6	15.7	41.3	53.1	13.6	41.5	53.8	14.6
HRS 3361	33.5	54.0	15.8	36.5	53.2	14.0	35.0	53.6	14.9
HRS 3419	32.8	55.4	16.2	35.0	52.1	14.3	33.9	53.8	15.3
HRS 3504	41.0	53.6	15.1	42.6	53.1	13.2	41.8	53.3	14.2
HRS 3530	46.8	55.8	16.8	37.0	53.3	14.8	41.9	54.5	15.8
HRS 3616†	38.7	55.5	16.0	36.5	56.9	14.0	37.6	56.2	15.0
SY Ingmar†	38.6	57.9	17.2	38.1	54.2	14.4	38.4	56.1	15.8
Linkert	39.1	57.0	15.9	38.5	56.2	14.5	38.8	56.6	15.2
Prevail	48.7	57.0	14.4	38.6	56.2	13.7	43.7	56.6	14.1
Prosper	40.4	51.5	15.6	39.2	52.8	13.2	39.8	52.2	14.4
RB07	43.1	57.2	15.7	40.0	55.8	14.1	41.6	56.5	14.9
SY Rustler	43.4	55.9	15.3	41.1	55.1	14.2	42.2	55.5	14.8
Select	45.5	57.5	14.9	35.8	56.5	13.9	40.6	57.0	14.4
Shelly†	44.0	57.0	15.9	43.7	56.1	13.4	43.9	56.5	14.6
Surpass	44.9	54.7	15.1	41.7	54.7	13.3	43.3	54.7	14.2
LCS Trigger	43.5	56.9	15.3	44.0	54.1	13.7	43.7	55.5	14.5
SY Valda	49.7	56.4	15.4	44.5	55.3	13.5	47.1	55.8	14.4
WB9312†	41.3	56.6	15.2	34.6	51.8	13.9	37.9	54.2	14.6
WB9507	41.0	54.4	15.6	37.8	53.0	13.8	39.4	53.7	14.7
WB9653	43.8	55.2	14.6	44.3	53.5	13.1	44.0	54.3	13.9
Trial Average	40.2	56.4	15.7	39.2	55.0	14.0	39.7	55.7	14.9
LSD(0.05)‡	4.8	1.7	0.6	6.3	1.9	0.5	3.9	1.3	0.4
CV(%)¶	8.5	2.2	2.4	11.5	2.5	2.6	10.1	2.3	2.5

† New entry in 2016, not previously tested.

‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, ¶ Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

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2016 South Dakota Spring Wheat Variety Trial Results

Table 6. 2016 West River Spring Wheat Performance, sorted by yield (13% M).

Variety	Crop Zone 6#					
	West River Average					
	Yield	Top 1/3 %*	Test Wt	Protein	Revenue/acre††	Revenue Rank
SY Valda	**47.1**	100	55.8	14.4	$215.26	4
WB9653	**44.0**	100	54.3	13.9	$192.07	14
Shelly†	**43.9**	100	56.5	14.6	$207.73	6
LCS Trigger	**43.7**	100	55.5	14.5	$200.00	8
Prevail	**43.7**	50	56.6	14.1	$185.53	19
Surpass	**43.3**	100	54.7	14.2	$191.15	15
LCS Anchor†	42.8	50	57.7	15.8	$237.44	2
SY Rustler	42.2	100	55.5	14.8	$199.92	9
HRS 3530	41.9	50	54.5	15.8	$239.02	1
HRS 3504	41.8	50	53.3	14.2	$177.54	22
RB07	41.6	50	56.5	14.9	$203.91	7
HRS 3100†	41.5	50	53.8	14.6	$196.72	11
Select	40.6	50	57.0	14.4	$185.70	18
Brick	40.3	0	57.8	14.5	$184.22	21
MS Chevelle	40.0	50	55.2	14.0	$174.56	25
Prosper	39.8	0	52.2	14.4	$175.49	24
Advance	39.5	50	55.0	14.7	$187.07	16
Focus	39.4	50	58.7	15.6	$218.44	3
WB9507	39.4	0	53.7	14.7	$186.48	17
Elgin-ND	39.3	0	55.6	15.1	$198.79	10
Faller	39.3	0	53.3	14.4	$173.28	28
Linkert	38.8	0	56.6	15.2	$196.26	12
SY Ingmar†	38.4	0	56.1	15.8	$212.69	5
WB9312†	37.9	0	54.2	14.6	$173.41	27
HRS 3616†	37.6	0	56.2	15.0	$184.34	20
HRS 3361	35.0	0	53.6	14.9	$171.53	29
Boost	34.4	0	54.7	15.1	$174.25	26
HRS 3419	33.9	0	53.8	15.3	$177.03	23
Bolles	32.8	0	55.2	17.1	$192.39	13
Forefront	32.7	0	57.3	14.8	$154.87	30
Trial Average	39.7	-	55.7	14.9	$192.24	-
LSD(0.05)‡	3.9	-	1.3	0.4	-	-
CV(%)¶	10.1	-	2.3	2.5	-	-

† New entry in 2016, not previously tested. ‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, ¶ Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

Bison was abandoned due to damage from chemical drift. *Top 1/3% is the percentage of time a variety yields in the top 1/3 of a location (includes some experimental lines not reported). ††Revenue is based on a cash price of $4.25/bu and a 10 year average Minneapolis grain exchange protein premium/discount schedule.

Table 7. 2014-2016 (2 and 3-year averages) East River Yield (bu/ac @ 13% M) Performance - sorted by overall 3-year yield. Varieties yielding in the upper 1/3 of each trial location are denoted by gray shading.

Variety	Crop Zone - 1						Crop Zone - 2				Zone - 4	Crop Zones 1, 2, & 4	
	Aberdeen		Faulkton		Selby		South Shore		Volga		Miller	East River Average	
	2 year	3 year	2 year	3 year	2 year	3 year	2 year	3 year	2 year	3 year	2 year*	2 year	3 year
HRS 3419	50.2	59.4	56.0	59.0	77.3	77.9	57.6	58.4	78.5	76.4	63.3	62.5	65.4
Prevail	51.6	58.7	54.3	57.5	80.7	78.4	57.8	62.8	75.4	73.5	58.8	62.5	64.8
MS Chevelle	52.1	59.9	55.9	58.3	85.9	84.3	53.4	53.5	69.8	67.4	66.3	63.2	64.7
HRS 3504	50.5	59.2	58.5	59.2	85.8	81.9	50.3	54.5	72.0	69.3	61.5	63.2	64.4
Surpass	47.0	56.5	53.2	57.5	84.6	83.6	54.3	59.7	69.6	70.6	57.2	61.1	64.3
Faller	48.1	58.6	47.9	54.4	90.1	89.1	45.2	54.3	67.6	69.1	60.7	58.7	63.9
Prosper	46.5	57.3	51.8	56.3	86.7	87.8	45.2	53.7	64.4	66.5	61.4	58.0	63.3
RB07	47.7	56.9	55.4	58.3	87.5	85.9	52.6	53.3	66.8	64.6	53.9	60.8	62.4
Focus	46.7	54.7	54.3	57.7	80.7	79.7	52.9	58.5	67.0	68.9	52.3	59.1	62.1
Advance	50.5	58.5	47.2	52.7	87.2	85.4	51.3	53.5	64.0	62.6	59.8	59.6	62.0
Brick	47.1	53.8	49.0	54.0	83.1	78.7	51.8	53.9	65.6	67.1	57.6	58.5	60.8
Boost	49.0	57.0	51.2	54.9	72.6	72.2	51.0	56.5	66.7	65.4	58.8	57.4	60.4
Forefront	45.9	55.3	51.4	56.4	80.0	72.3	53.5	56.4	69.1	69.2	52.6	58.1	60.2
Select	50.0	58.5	46.4	52.7	81.3	77.0	51.6	50.2	68.6	67.0	56.5	58.6	60.1
Linkert	49.8	54.7	54.5	55.0	77.2	78.1	51.4	54.2	63.3	60.7	54.1	58.4	59.5
Elgin	47.0	54.2	51.1	54.1	74.1	74.9	47.2	52.2	62.3	61.8	56.6	56.3	58.8
Bolles	42.4	53.0	49.8	54.1	76.9	76.5	46.5	51.5	63.1	63.3	54.9	54.9	58.7
HRS 3361	44.4	53.7	53.6	56.4	74.9	74.2	43.3	50.3	61.0	62.8	54.3	54.3	58.2
WB9507	42.3	53.0	47.4	53.7	86.6	83.3	31.2	42.0	47.6	57.2	60.2	50.9	57.3
LCS Trigger	57.9	-	62.2	-	95.7	-	62.6	-	78.7	-	-	69.8	-
SY Valda	51.9	-	55.4	-	89.6	-	54.2	-	75.9	-	-	65.1	-
WB9653	52.6	-	59.5	-	87.4	-	50.1	-	73.7	-	-	64.1	-
SY Rustler	49.0	-	57.6	-	86.1	-	54.0	-	75.5	-	-	63.6	-
HRS 3530	45.1		53.2		91.3		46.2		67.2			59.6	
HRS 3100†	-	-	-	-	-	-	-	-	-	-	-	-	-
HRS 3616†	-	-	-	-	-	-	-	-	-	-	-	-	-
LCS Anchor†	-	-	-	-	-	-	-	-	-	-	-	-	-
Shelly†	-	-	-	-	-	-	-	-	-	-	-	-	-
SY Ingmar†	-	-	-	-	-	-	-	-	-	-	-	-	-
WB9312†	-	-	-	-	-	-	-	-	-	-	-	-	-
Trial Average	48.4	56.4	55.2	57.6	82.7	80.0	50.8	54.2	68.0	66.5	57.8	60.4	62.3
LSD(0.05)‡	3.0	2.7	5.1	4.0	3.4	2.9	3.1	2.6	3.4	2.7	3.7	5.9	5.2

* Miller 2-year data is from 2014 and 2016.

† New entry in 2016, not previously tested.

‡ Yield value required (≥LSD) to determine if varieties are statistically different than one another.

2016 South Dakota
Spring Wheat Variety Trial Results

Table 8. 2014-2016 (2 and 3-year averages) West River Yield (bu/ac @ 13% M) Performance - sorted by overall 3-year yield. Varieties yielding in the upper 1/3 of each trial location are denoted by gray shading.

Variety	Crop Zone - 7	Crop Zone - 6		Crop Zone 6	
	Draper	Wall		West River Average	
	2 year*	2 year	3 year	2 year	3 year
Prevail	**62.1**	47.5	**48.0**	**46.6**	**50.3**
WB9507	54.8	46.7	**52.2**	44.2	**49.8**
Surpass	**58.7**	47.8	**47.9**	45.8	**49.4**
Prosper	52.6	48.9	**50.7**	45.7	**49.3**
MS Chevelle	53.3	48.2	**50.8**	45.8	**48.9**
RB07	54.6	49.5	**48.8**	**46.8**	**48.3**
Elgin	52.9	45.1	47.3	42.5	**47.1**
Faller	51.1	48.6	**48.8**	44.8	**47.0**
Select	**56.9**	43.3	44.5	42.7	**46.6**
HRS 3504	50.9	48.5	**48.3**	45.4	**46.6**
Focus	51.5	44.2	**48.0**	41.3	**46.4**
Brick	52.5	44.5	47.0	42.5	**46.3**
Advance	54.7	44.1	44.1	42.8	**46.0**
Linkert	51.5	43.9	45.8	41.5	**45.7**
HRS 3419	46.9	48.0	**50.7**	43.2	**45.4**
Forefront	50.6	40.8	44.6	36.8	43.8
Bolles	48.1	38.8	43.7	37.4	43.0
HRS 3361	48.2	41.2	43.0	38.1	42.9
Boost	45.0	43.9	44.5	40.7	41.4
SY Valda	-	**54.1**	-	**51.9**	-
LCS Trigger	-	**52.1**	-	**48.8**	-
SY Rustler	-	**50.6**	-	**47.7**	-
HRS 3530	-	48.5	-	**47.0**	-
WB9653	-	47.8	-	45.5	-
HRS 3100†	-	-	-	-	-
HRS 3616†	-	-	-	-	-
LCS Anchor†	-	-	-	-	-
Shelly†	-	-	-	-	-
SY Ingmar†	-	-	-	-	-
WB9312†	-	-	-	-	-
Trial Average	52.2	46.5	47.3	44.6	45.7
LSD(0.05)‡	5.3	4.2	4.6	5.3	5.6

* Draper 2-year data is from 2014 and 2016.

† New entry in 2016, not previously tested.

‡ Yield value required (≥LSD) to determine if varieties are statistically different than one another.

2016 South Dakota Spring Wheat Variety Trial Results

Table 9. List of spring wheat varieties tested in 2016 along with origin, agronomic and grain quality characteristics, and disease ratings.

	Testing and Origin		Agronomic Characteristics			Grain Quality		Disease Ratings¶				
Variety	Years Tested in SD	Origin†-Year	Relative Hdg‡ (days)	Relative Ht‡ (inches)	Lodging Score§	Test Wt.	Protein %	Stripe Rust	Stem Rust	Leaf Rust	2016 BLS	2016 FHB (scab)
Advance	5+	SD-11	4	-3	1.5	Avg.	Avg.	MR	R-MR	MR-MS	MS	MR
LCS Anchor	new	LCS-16	2	-4	1.4	Avg.	Good	*(MR)*	-	*(MR)*	MR	MS
Bolles	4	MN-15	6	-1	1.2	Low	High	MR	-	*(R)#*	MS	MS
Boost	4	SD-exp	6	-1	1.2	Avg.	Avg.	MS	-	MR	MR	MS
Brick	5+	SD-08	0	0	1.4	Good	Avg.	MS	R	MR-MS	MR	MR
MS Chevelle	3	MS-14	2	-3	1.2	Avg.	Low	*(MR)*	*(MR)*	*(R)*	S	MS
Elgin-ND	5+	ND-12	3	2	1.3	Avg.	Avg.	MS	R	MS	MS	MS
Faller	5+	ND-07	6	-1	1.3	Low	Low	S	R	MS	MS	MS
Focus	4	SD-15	-1	2	1.4	Good	Avg.	MS	-	S	MR	MR
Forefront	5+	SD-11	1	2	1.3	Avg.	Avg.	MR	R-MR	MS	MR	MR
HRS 3100	new	CP-16	5	-3	1.0	Avg.	Avg.	-	-	-	MS	MS
HRS 3361	3	CP-14	5	-3	1.0	Low	Avg.	*(MS)*	*(MR)*	*(MR)*	MS	MS
HRS 3419	3	CP-15	6	-2	1.2	Low	Avg.	*(MR)*	*(R)*	*(R)*	S	MS
HRS 3504	2	CP-15	5	-3	1.0	Avg.	Avg.	*(MR)*	*(MR)*	*(MR)*	MS	MS
HRS 3530	2	CP-16	6	1	1.3	Avg.	Avg.	*(MS)*	*(R)*	*(R)*	MS	MS
HRS 3616	new	CP-17	5	-2	1.0	Avg.	Avg.	-	-	-	MS	MS
SY Ingmar	new	SY-14	5	-3	1.1	Avg.	Avg.	-	*(R)*	*(MR)*	MR	MR
Linkert	5+	MN-13	4	-4	1.0	Avg.	Good	MR	-	MR-MS	MR	MS
Prevail	5+	SD-13	1	-2	1.4	Avg.	Avg.	MR	MR	MS	MR	MR
Prosper	5+	ND-11	5	-1	1.6	Low	Avg.	S	R	MS	MS	MS
RB07	5+	MN-07	3	-2	1.4	Avg.	Avg.	MS	MR	MR	MS	MS
SY Rustler	2	SY-16	3	-3	1.3	Avg.	Avg.	MR	-	MR	MR	MS
Select	5+	SD-09	0	-1	1.5	Good	Avg.	MR	R-MR	MR-MS	MR	MR
Shelly	new	MN-16	7	-3	1.2	Avg.	Avg.	-	-	-	MS	MS
Surpass	3	SD-exp	1	-1	1.5	Avg.	Avg.	-	-	-	MR	MR
LCS Trigger	new	LCS-15	7	-1	1.1	Avg.	Low	MS	*(R)*	*(R)*	MS	S
SY Valda	new	SY-15	4	-3	1.2	Avg.	Avg.	MS	-	MR	MR	MR
WB9312	new	WB-16	2	-3	1.4	Avg.	Low	-	-	-	MR	MS
WB9507	3	WB-14	4	-1	1.3	Low	Avg.	*(MR)*	*(MR)*	*(MR)*	MR	MS
WB9653	new	WB-15	5	-4	1.1	Avg.	Avg.	MR	-	MR	MR	MR

† CP, Croplan; LCS, Limagrain Cereal Seeds; MN, Minnesota; MS, Meridian Seeds; ND, North Dakota; SD, South Dakota; SY, Syngenta; WB, Westbred and - (Year of Release)

‡ Difference in days to heading and height in inches compared to **Brick (31 inches)** statewide.

§ Lodging scores range from 1 (perfectly standing) to 5 (completely flat).

¶ Disease ratings: R, resistant; MR, moderately resistant; MS, moderately susceptible; S, susceptible.

\# Estimated ratings *(X)*, based on information provided by the entity that submitted the variety.

2016 South Dakota Winter Wheat Variety Trial Results

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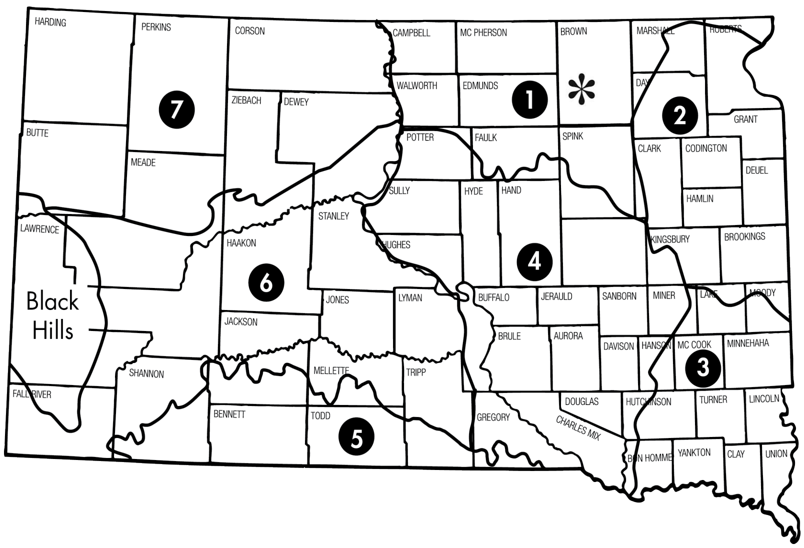

Recommended Winter Wheat Varieties for Fall 2016 by Crop Zone†

Zone - 1pc	Zone - 2pc	Zone - 3	Zone - 4pc	Zone - 5	Zone - 6	Zone - 7pc
Oahe	Ideal‡	Ideal‡	Redfield	Redfield	Ideal‡	Ideal‡
Redfield	Denali	Oahe	Denali	Oahe	Oahe	Lyman
Denali	Freeman‡	Denali	Freeman‡	Denali	Denali	Denali
Freeman‡	LCS Mint‡	Freeman‡	LCS Mint‡	Freeman‡	Freeman‡	LCS Mint‡
LCS Mint‡	Overland	SY Wolf‡	SY Wolf‡	LCS Mint‡	LCS Mint‡	SY Wolf‡
SY Wolf‡	SY Wolf‡	WB Grainfield‡	WB Grainfield‡	Overland	SY Wolf‡	WB Grainfield‡
WB Grainfield‡						

Promising

Antero‡ (white)	Antero‡ (white)	Antero‡ (white)	Antero‡ (white)	Antero‡ (white)	Antero‡ (white)	Antero‡ (white)
SY Monument	SY Monument	LCS Compass	SY Monument	SY Monument	SY Monument	SY Monument
					Ruth‡	

* Multi-year averages are not available for this zone, however it is suggested to select a variety that appears frequently in the recommended list across all zones for the state or neighboring zones.

† Crop Zones for small grains are base on soil & climate information. Recommended varieties are in the top 1/3 of the trial over 3 years for each zone. Promising varieities are those in the top 1/3 of the trial over 2 years.

pc plant in protective cover to improve winter survival in Crop Zones 1, 2, 4, & 7 and in other zones when planting varieties with (Fair) or lower winterhardiness ratings

‡ Variety is susceptible or moderately susceptible to Fusarium Head Blight (Scab).

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2016 South Dakota Winter Wheat Variety Trial Results

Table 1. List of 2016 winter wheat testing locations and soil/cultural characteristics.

Location	Testing location characteristics				
	Cooperator	GPS coordinates	Soil Type	Previous crop	Tillage system
East River Locations (8)					
Beresford	Southeast Research Farm	43.043002° -96.901634°	Egan-Clarno-Trent complex, 0-2% slopes	Oats	No-till
Brookings	SDSU Foundation Seed	44.428208° -96.795120°	Kranzburg-Brookings silty clay loams, 0-2% slopes	Sp Wht	Min-till
Brookings - w/fungicide	SDSU Foundation Seed	44.128208° -96.795120°	Kranzburg-Brookings silty clay loams, 0-2% slopes	Sp Wht	Min-till
Onida	Tom Young	44.702751° -100.385525°	Agar silt loam, 0-2% slopes	Sp Wht	No-till
Pierre	Dakota Lakes	44.293688° -99.997029°	Millboro silty clay loam, 0-2% slopes	Flax	No-till
Platte (Geddes)	Curt Sybesma	43.265087° -98.663588°	Highmore-Walke silt loams, 0-2% slopes	Soybeans	No-till
Selby	Mark Stiegelmeyer	45.441954° -100.059511°	Highmore silt loam, cool, 2-6% slopes	Lentils	No-till
South Shore	Northeast Research Farm	45.105893° -97.101744°	Kranzburg-Brookings silty clay loams, 0-2% slopes	Oats	No-till
West River Locations (9)					
Bison	Brad Seidel	45.529722° -102.401111°	Felor-Yegen loams, 2-6% slopes	Sp Wht	No-till
Hayes	RDO	44.497778° -100.720556°	Opal-Chantier clays, 2-6% slopes	W Wht	No-till
Kennebec (Vivian)	Larson's c/o Logan Ruman	44.006389° -100.194722°	Millboro silty clay, 3-6% slopes	Sp Wht	No-till
Martin	Mary Kay and Carl Novotny	43.187778° -101.656667°	Mobridge silt loam, 0-3% slopes	Millet	No-till
Faith (Dupree)	Bryant Schauer	45.055833° -101.731389°	Daglum-Rhoades loams, 2-6% slopes	Fallow	No-till
Sturgis	Dave Wilson	44.503333° -103.481389°	Nunn clay loams, 0-2% slopes	W Wht	No-till
Wall	Dale Patterson	44.095833° -102.338056°	Santana loam, 0-2% slopes	Fallow	No-till
Winner	Jorgenson Land & Cattle	43.500591° -99.912924°	Millboro silty clay, 0-3% slopes	Oats	No-till
Winner - intensive	Jorgenson Land & Cattle	43.500591° -99.912924°	Millboro silty clay, 0-3% slopes	Oats	No-till

2016 South Dakota Winter Wheat Variety Trial Results

Table 2. Agronomic practices for 2016 winter wheat trial locations.

Location	Agronomic practices					
	Planting date	Starter applied	Other Fertilizer applied	Herbicide applied	Fungicide applied	Harvest date
East River Locations (8)						
Beresford	09/16/15	90# 30-10-10	300# 46-0-0 4/11/16	1.7 pt Wolverine	none	7/14/16
Brookings	09/14/15	45# 30-10-10	225# 46-0-0 4/11/16	1.5 pt Brox M Ultra	none	7/13/16
Brookings - w/fungicide	09/14/15	45# 30-10-10	225# 46-0-0 4/11/16	1.5 pt Brox M Ultra	5 oz Prosaro (heading)	7/13/16
Onida	09/11/15	10 gals 10-34-0	250# 46-0-0 3/13/16	1 pt GoldSky	none	7/12/16
Pierre	09/12/15	10 gals 10-34-0	50 gal 28-0-0 streambar 4/8/16	0.9 pt Bromac Adv. + Harmony	none	7/11/16
Platte (Geddes)	10/06/15	90# 30-10-10	220# 46-0-0 4/4/16	none	none	7/14/16
Selby	09/11/15	10 gals 10-34-0	250# 46-0-0 3/13/16	none	none	7/28/16
South Shore	09/15/15	90# 30-10-10	300# 46-0-0 4/6/16	none	none	7/18/16
West River Locations (9)						
Bison	9/21/15	6 gal 10-25-0-5.5Zn	35 gal 28-0-0 mid-row band	none	none	8/1/16
Hayes	09/23/15	6 gal 10-25-0-5.5Zn	35 gal 28-0-0 mid-row band	8 oz Olympus (fall) 16 oz Goldsky	2 oz Bumper (flag lf) 4 oz Triazol (heading)	7/14/16
Kennebec (Vivian)	09/23/15	6 gal 10-25-0-5.5Zn	35 gal 28-0-0 mid-row band	5 oz Barrage	6 oz Avaris (flag lf & heading)	7/21/16
Martin	09/22/15	6 gal 10-25-0-5.5Zn	35 gal 28-0-0 mid-row band	none	none	7/22/16
Faith (Dupree)	09/25/15	6 gal 10-25-0-5.5Zn	35 gal 28-0-0 mid-row band	16 oz Goldsky	4 oz Stratego (heading)	7/25/16
Sturgis	09/28/15	6 gal 10-25-0-5.5Zn	35 gal 28-0-0 mid-row band	16 oz Goldsky	4 oz Stratego (heading)	7/11/16
Wall	09/25/15	6 gal 10-25-0-5.5Zn	35 gal 28-0-0 mid-row band	3.5 oz Power Flex (fall applied)	none	7/15/16
Winner†	10/12/15	10 gals 10-34-0	250# 46-0-0 3/13/16	1.5 pt Maestro	none	7/14/16
Winner - intensive†	10/12/15	4 gals 7-25-5 + 0.5 gal inFuze	250# 46-0-0 3/13/16	13.5 oz Starane Flex	none‡	7/14/16

‡ Plots at both Winner trials were missing one row, i.e., there were 6 rows instead of 7.

†Due to extremely wet conditions, the cooperator was not able to apply fungicide.

2016 South Dakota Winter Wheat Variety Trial Results

Table 3a. 2016 East River Winter Wheat Performance - Yield (13% moisture), Test Weight (harvest moisture), and Protein (13% moisture). Varieties yielding in the upper 1/3 of each trial location are denoted by gray shading.

Variety	Crop Zone - 1			Crop Zone - 2					
	Selby			Brookings			Brookings w/fung.#		
	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein
Alice (White)	111.0	59.4	12.7	57.6	58.2	12.3	52.3	58.1	12.9
Antero (White)	111.0	60.8	10.6	73.9	59.8	11.9	81.3	60.2	12.2
Avery†	92.0	59.0	11.0	68.8	59.5	12.2	72.2	60.4	11.6
Brawl CL Plus	109.6	59.7	12.2	57.1	56.9	13.8	65.4	57.9	13.7
Byrd	97.1	59.5	11.0	66.9	58.5	12.1	68.0	59.4	12.2
LCS Compass	83.4	61.0	11.9	55.2	58.5	12.6	58.9	60.0	12.0
Cowboy†	97.2	59.2	11.2	68.4	57.6	11.6	71.6	58.8	12.0
Decade	87.4	58.3	11.5	57.7	58.9	12.1	66.0	59.8	12.2
Denali	95.3	60.2	11.1	75.9	58.7	10.9	80.5	60.0	11.7
AC Emerson	84.2	60.2	13.5	55.7	59.4	12.9	56.8	60.3	12.3
Expedition	77.6	59.0	12.0	62.4	58.1	12.3	61.1	59.0	11.9
Freeman	105.5	57.4	12.4	73.3	57.6	12.0	67.1	57.8	12.4
WB-Grainfield	110.7	59.1	12.1	78.1	58.7	12.4	73.1	60.2	12.6
Ideal	85.8	59.2	12.0	68.8	59.0	11.8	69.9	58.7	11.3
Lyman	92.4	60.0	12.7	70.8	59.2	13.0	65.2	59.4	12.6
LCS Mint	112.9	61.6	11.8	69.4	60.9	12.1	73.7	60.9	12.0
SY Monument	110.9	59.7	12.2	79.1	58.0	11.9	79.1	58.8	11.9
Oahe	110.7	60.9	11.8	70.8	59.2	12.2	75.9	59.4	12.2
Overland	107.6	59.7	12.4	62.9	58.9	12.3	68.1	59.6	12.5
PSB13NEDH-7-140†	118.9	61.3	12.9	70.1	60.0	12.9	64.0	59.3	13.5
Redfield	111.2	60.4	12.0	69.0	59.5	11.9	71.3	59.7	12.4
Ruth	115.4	60.0	11.8	70.4	59.9	12.7	72.0	60.1	12.6
SY Sunrise†	121.8	60.7	11.6	67.7	58.2	12.5	73.3	59.5	12.7
WB4059-CLP	87.5	59.3	12.3	62.7	50.8	11.4	53.4	53.1	13.1
WB4614	88.9	60.5	11.8	74.1	58.4	12.7	80.4	59.2	12.2
Wesley	100.7	58.1	11.6	65.7	58.2	12.6	67.0	59.4	12.7
SY Wolf	110.0	61.1	11.5	82.9	58.2	12.4	76.7	59.4	12.7
Trial Average	102.4	59.9	11.9	67.8	58.5	12.3	68.2	59.2	12.4
LSD(0.05)‡	10.4	0.8	1.0	7.3	1.3	0.9	6.1	1.4	1.2
CV(%)§	7.3	0.9	5.9	7.7	1.5	5	6.5	1.8	6.7

Foliar fungicide applied at flowering.

† New entry in 2016, not previously tested.

‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, § Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

Table 3b. 2016 East River Winter Wheat Performance, continued - Yield (13% moisture), Test Weight (harvest moisture), and Protein (13% moisture). Varieties yielding in the upper 1/3 of each trial location are denoted by gray shading.

Variety	Crop Zone - 2			Crop Zone - 3			Crop Zone - 4		
	South Shore			Beresford			Dakota Lakes		
	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein
Alice (White)	73.2	55.9	14.0	65.8	55.7	12.5	63.7	55.2	14.5
Antero (White)	79.1	55.4	13.7	74.8	56.7	11.7	66.2	53.9	14.6
Avery†	77.6	55.6	13.4	73.3	55.9	12.3	53.6	53.3	14.6
Brawl CL Plus	78.6	57.3	13.5	72.4	58.7	12.3	64.1	53.7	15.4
Byrd	69.3	55.0	13.6	73.4	56.9	11.6	69.0	54.0	14.2
LCS Compass	72.8	56.7	14.4	68.6	59.8	12.3	57.9	53.8	15.0
Cowboy†	70.9	54.9	13.5	73.6	54.5	12.2	60.0	50.4	14.7
Decade	56.0	53.9	14.7	52.1	55.6	12.3	55.6	53.5	15.2
Denali	75.5	55.8	14.1	68.9	55.7	12.6	61.8	51.7	15.4
AC Emerson	52.7	54.9	15.1	43.0	51.3	12.5	51.5	55.7	14.9
Expedition	67.5	55.6	14.5	59.7	55.4	12.0	58.4	52.6	15.1
Freeman	65.3	52.0	14.4	75.0	56.0	11.9	63.5	51.5	15.6
WB-Grainfield	69.2	53.6	14.1	77.3	58.0	12.0	59.1	52.7	15.5
Ideal	75.2	56.1	14.4	60.7	56.0	12.5	56.4	53.4	14.7
Lyman	69.5	56.1	14.0	58.3	55.7	12.3	63.2	54.5	14.8
LCS Mint	76.8	57.4	13.7	71.7	58.5	11.6	67.6	54.7	15.0
SY Monument	77.0	54.4	14.0	63.5	53.2	12.0	67.1	50.3	14.3
Oahe	69.9	57.8	14.0	61.3	56.7	12.0	63.9	57.3	14.8
Overland	73.1	57.7	13.8	61.6	57.1	11.9	63.6	55.6	14.3
PSB13NEDH-7-140†	72.9	57.1	14.6	63.9	57.9	12.6	64.2	56.0	15.7
Redfield	66.5	54.8	15.0	61.8	55.7	12.7	65.2	55.4	15.1
Ruth	66.9	54.5	14.5	74.4	57.8	12.1	64.2	54.7	14.9
SY Sunrise†	79.9	55.5	13.9	72.5	56.6	11.9	70.8	54.3	14.5
WB4059-CLP	66.5	50.7	14.7	67.8	53.1	12.8	55.4	46.2	15.0
WB4614	64.6	55.4	14.5	55.0	52.7	12.2	65.9	53.0	14.6
Wesley	68.5	53.8	15.1	70.6	55.6	12.5	59.1	49.8	15.8
SY Wolf	68.9	54.4	14.4	74.0	54.8	12.3	69.5	53.6	14.3
Trial Average	69.2	55.1	14.2	66.0	55.9	12.2	61.8	53.4	15.0
LSD(0.05)‡	6.0	1.3	0.8	6.4	1.4	0.9	9.9	2.4	1.2
CV(%)§	6.1	1.6	4.2	6.9	1.8	5.1	11.5	3.4	5.8

† New entry in 2016, not previously tested.

‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, § Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

Table 3c. 2016 East River Winter Wheat Performance, continued - Yield (13% moisture), Test Weight (harvest moisture), and Protein (13% moisture). Varieties yielding in the upper 1/3 of each trial location are denoted by gray shading.

Variety	Crop Zone - 4						Crop Zones 1, 2, 3, & 4			
	Geddes			Onida			East River Average			
	Yield	Test Wt	Protein	Yield	Test Wt	Protein	Top 1/3%	Yield	Test Wt	Protein
Alice (White)	100	59.8	13.1	62.7	55.5	15.7	50	73.2	57.2	13.4
Antero (White)	99	57.4	12.3	64.4	53.7	14.8	88	81.1	57.2	12.7
Avery†	99	58.2	11.7	61.5	53.0	14.7	38	74.6	56.9	12.7
Brawl CL Plus	99	60.5	12.8	63.5	54.3	15.6	50	76.2	57.4	13.6
Byrd	106	58.8	12.0	67.6	54.4	14.5	50	77.0	57.1	12.6
LCS Compass	100	60.6	12.9	58.5	56.0	15.4	0	69.3	58.3	13.3
Cowboy†	102	59.0	12.0	56.1	51.7	15.6	25	74.8	55.7	12.8
Decade	99	60.6	13.0	47.3	54.4	15.5	0	65.0	56.9	13.3
Denali	106	59.4	12.3	69.4	53.4	15.4	63	79.0	56.9	12.9
AC Emerson	75	59.3	13.6	48.6	55.0	16.7	0	58.3	57.0	13.9
Expedition	103	60.5	12.8	62.2	53.7	16.1	13	68.8	56.7	13.3
Freeman	107	58.2	12.7	62.4	51.2	16.2	50	77.2	55.2	13.4
WB-Grainfield	103	59.8	12.4	58.3	54.5	15.8	63	78.5	57.1	13.4
Ideal	99	61.2	12.9	50.1	53.2	16.6	13	70.5	57.1	13.2
Lyman	98	59.6	13.4	54.6	55.6	16.4	13	71.3	57.5	13.6
LCS Mint	100	59.3	12.4	69.0	54.2	15.1	75	80.0	58.4	13.0
SY Monument	99	56.9	12.4	61.4	52.0	15.4	63	79.6	55.4	13.0
Oahe	97	61.4	12.3	51.5	55.4	16.2	38	75.0	58.5	13.2
Overland	96	60.7	12.8	59.2	56.2	15.2	13	73.9	58.2	13.1
PSB13NEDH-7-140†	102	62.4	13.4	60.4	57.0	15.9	50	76.9	58.9	13.9
Redfield	96	60.6	12.8	63.8	56.3	15.3	38	75.4	57.8	13.4
Ruth	108	60.7	12.8	60.1	55.3	15.6	75	78.8	57.9	13.4
SY Sunrise†	109	60.5	12.3	68.7	56.0	15.4	88	82.9	57.7	13.1
WB4059-CLP	88	55.9	13.6	50.8	38.5	16.0	0	66.4	50.9	13.9
WB4614	89	57.5	12.9	49.6	51.3	16.5	38	70.7	56.0	13.4
Wesley	96	58.2	12.5	56.1	53.0	16.4	0	72.9	55.8	13.6
SY Wolf	105	60.6	12.7	58.2	52.7	15.9	75	80.5	56.9	13.3
Trial Average	98.4	59.7	12.7	59.5	53.8	15.7	-	74.1	57	13.3
LSD(0.05)‡	4.8	1.4	0.6	8.9	4.9	1.5	-	5.6	1.2	0.4
CV(%)§	3.5	1.6	3.6	10.6	6.5	5.5	-	7.5	2.8	5.6

† New entry in 2016, not previously tested.

‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, § Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

2016 South Dakota Winter Wheat Variety Trial Results

Table 4a. 2016 West River Winter Wheat Performance - Yield (13% moisture), Test Weight (harvest moisture), and Protein (13% moisture). Varieties yielding in the upper 1/3 of each trial location are denoted by gray shading.

Variety	Crop Zone - 5			Crop Zone - 6								
	Martin			Hayes			Kennebec			Sturgis		
	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein
Alice (White)	77.2	58.9	13.0	56.1	54.9	15.0	53.9	58.0	10.7	60.6	61.7	9.6
Antero (White)	94.7	60.1	12.7	45.6	49.5	14.7	-	-	-	72.7	60.9	8.6
Avery†	87.0	60.0	11.0	47.8	52.4	15.2	64.3	58.6	9.1	71.5	60.5	8.2
Brawl CL Plus	76.9	60.3	13.0	51.2	50.2	16.3	52.1	59.1	10.7	64.8	63.1	9.4
Byrd	84.0	52.6	12.6	47.0	51.8	14.9	59.4	59.0	8.7	69.8	60.2	9.0
LCS Compass	75.0	60.7	13.1	42.4	52.6	15.9	47.3	58.4	9.6	57.0	61.9	10.2
Cowboy†	84.6	58.3	12.8	42.7	49.1	15.7	60.4	56.1	8.8	68.1	59.9	8.9
Decade	81.8	59.5	12.5	39.3	54.0	16.1	54.0	59.8	10.2	59.1	61.9	10.2
Denali	82.8	59.8	12.1	45.8	51.9	15.6	59.2	59.0	8.9	62.7	62.1	9.2
AC Emerson	66.1	60.0	12.5	37.2	55.9	16.5	46.0	59.9	10.9	49.2	62.4	10.9
Expedition	64.7	58.2	12.2	48.2	49.4	16.1	53.8	58.9	10.0	62.7	61.0	9.1
Freeman	86.6	58.3	12.1	42.6	47.6	16.1	57.2	56.3	9.1	65.9	59.4	9.0
WB-Grainfield	95.1	61.0	12.2	46.1	50.1	16.9	61.2	57.6	10.9	68.2	60.8	9.4
Ideal	79.8	59.7	11.6	38.6	53.6	16.7	58.1	58.5	9.6	60.5	62.3	9.3
Lyman	77.2	59.6	13.2	47.6	52.5	16.5	51.2	58.7	9.9	61.5	61.0	9.4
LCS Mint	91.4	60.4	12.8	43.8	55.9	15.5	61.6	59.3	9.3	67.0	62.8	9.2
SY Monument	92.2	59.8	12.4	43.7	50.4	15.8	61.8	56.0	9.3	61.2	59.4	8.8
Oahe	86.7	62.2	12.4	39.9	53.9	15.9	51.1	59.8	9.4	68.6	62.1	9.3
Overland	87.9	61.0	11.8	46.6	54.5	16.6	53.1	58.6	9.5	66.0	61.1	8.8
PSB13NEDH-7-140†	90.0	61.6	12.3	47.4	56.0	16.9	54.4	59.6	9.8	59.4	62.6	10.2
Redfield	85.1	61.1	12.2	44.8	53.0	16.6	52.5	59.5	9.8	62.7	61.7	9.8
Ruth	83.8	60.4	12.8	48.1	52.5	16.3	54.9	59.3	9.7	64.0	62.7	9.2
SY Sunrise†	80.2	61.0	12.7	46.8	51.5	15.5	52.7	57.9	10.3	63.0	61.7	9.5
WB4059-CLP	75.4	54.5	12.3	45.3	45.7	15.7	46.7	55.9	11.0	66.8	52.1	9.2
WB4614	86.3	59.9	12.3	40.3	52.0	16.6	57.0	59.2	9.3	69.3	61.5	9.2
Wesley	75.1	58.8	13.7	43.7	48.8	16.6	51.6	58.3	10.2	64.7	60.9	10.0
SY Wolf	81.1	59.3	12.8	44.7	52.0	16.7	56.3	58.4	9.7	66.2	61.9	9.1
Trial Average	81.7	59.6	12.6	44.5	51.9	16.0	54.4	58.5	9.8	63.4	61.0	9.4
LSD(0.05)‡	12.1	4.0	1.1	6.9	2.5	0.8	7.0	2.1	0.6	6.4	1.3	0.5
CV(%)§	9.8	4.7	6.3	11.1	3.5	2.4	7.0	1.7	3.5	7.1	1.5	2.4

† New entry in 2016, not previously tested.

‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, § Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

Table 4b. 2016 West River Winter Wheat Performance, continued - Yield (13% moisture), Test Weight (harvest moisture), and Protein (13% moisture). Varieties yielding in the upper 1/3 of each trial location are denoted by gray shading.

Variety	Crop Zone - 6								
	Wall			Winner			Winner intensive		
	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein
Alice (White)	55.8	55.5	9.3	76.2	56.0	13.2	79.8	58.0	12.9
Antero (White)	65.6	56.9	9.1	82.3	55.8	11.9	81.9	58.2	11.7
Avery†	69.0	56.4	9.5	75.2	55.4	12.2	69.3	56.8	12.5
Brawl CL Plus	56.4	58.1	9.6	77.1	56.7	13.3	75.0	57.7	13.4
Byrd	67.0	55.7	8.5	72.6	54.7	12.9	70.2	55.8	13.0
LCS Compass	53.7	57.4	9.3	72.6	58.6	12.2	68.9	59.6	13.0
Cowboy†	75.0	54.6	8.9	77.9	54.8	12.1	72.8	58.0	12.0
Decade	56.8	55.9	9.2	67.1	58.6	12.6	60.9	59.1	13.0
Denali	72.7	56.5	8.8	76.4	56.6	12.7	78.8	59.4	11.9
AC Emerson	52.6	54.8	9.3	62.3	59.5	13.4	59.1	60.2	13.7
Expedition	55.4	56.7	9.0	71.6	54.7	12.9	67.0	58.1	12.6
Freeman	66.0	55.2	9.4	81.0	54.0	12.7	70.0	54.9	13.1
WB-Grainfield	58.7	57.1	9.5	81.6	54.4	12.3	76.4	57.3	12.3
Ideal	66.1	56.7	9.8	74.0	58.3	12.6	67.8	59.4	12.7
Lyman	60.3	55.2	8.6	76.5	57.5	12.6	78.3	59.5	12.5
LCS Mint	66.4	57.8	8.9	88.8	57.7	11.9	88.6	61.0	12.5
SY Monument	72.2	55.2	8.9	82.7	55.2	12.5	79.6	56.3	12.5
Oahe	63.9	58.6	9.7	70.0	59.3	12.8	71.6	60.3	12.9
Overland	65.2	54.9	8.7	79.6	58.9	12.0	74.8	59.9	12.2
PSB13NEDH-7-140†	62.9	57.1	9.3	79.5	60.4	12.6	68.8	61.5	13.3
Redfield	63.1	56.1	9.2	71.1	57.5	14.1	69.0	59.4	13.7
Ruth	60.7	57.6	10.1	79.9	56.7	13.5	78.1	58.1	12.7
SY Sunrise†	65.1	57.5	9.7	81.2	56.9	12.9	76.4	58.1	13.0
WB4059-CLP	57.9	52.4	9.7	65.7	53.6	13.7	64.6	55.3	13.9
WB4614	72.9	55.6	9.1	64.0	56.4	12.8	71.1	60.6	12.7
Wesley	56.9	54.7	9.8	75.5	56.5	12.9	77.0	57.7	13.0
SY Wolf	62.4	55.5	10.1	83.8	57.4	12.4	69.0	60.3	12.2
Trial Average	61.8	56.1	9.3	74.5	56.7	12.8	72.0	58.5	12.8
LSD(0.05)‡	6.7	1.3	0.8	7.8	2.1	1.1	9.6	1.5	0.9
CV(%)§	7.8	1.7	4.1	7.5	2.6	6.0	9.4	1.9	5.0

† New entry in 2016, not previously tested.

‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, § Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

Table 4c. 2016 West River Winter Wheat Performance, continued - Yield (13% moisture), Test Weight (harvest moisture), and Protein (13% moisture). Varieties yielding in the upper 1/3 of each trial location are denoted by gray shading.

Variety	Crop Zone - 7						Crop Zones 5, 6, & 7			
	Bison			Faith			West River Average			
	Yield	Test Wt	Protein	Yield	Test Wt	Protein	Top 1/3%	Yield	Test Wt	Protein
Alice (White)	34.2	58.3	12.4	85.2	60.8	10.9	22	65.6	58.0	12.0
Antero (White)	48.8	57.3	11.1	108.0	61.4	8.9	78	74.9	57.5	11.1
Avery†	40.6	55.4	12.6	82.3	60.2	9.9	56	67.8	57.1	11.2
Brawl CL Plus	41.9	57.8	12.4	91.5	61.6	10.5	44	66.8	58.2	12.2
Byrd	41.4	56.1	12.5	85.3	61.7	8.7	56	67.1	56.1	11.4
LCS Compass	36.4	57.0	13.2	82.6	62.6	10.1	0	61.1	58.8	12.0
Cowboy†	35.7	54.5	13.0	86.6	60.7	10.2	44	67.9	56.2	11.5
Decade	36.7	58.2	13.4	79.4	62.7	9.2	0	60.1	58.7	11.8
Denali	41.2	55.5	12.6	88.0	61.9	10.3	56	68.6	58.0	11.5
AC Emerson	29.1	57.9	15.0	74.7	62.2	11.1	0	53.8	59.1	12.5
Expedition	36.4	56.6	13.0	88.1	60.9	10.3	11	61.7	56.9	11.8
Freeman	33.1	54.7	12.4	84.4	58.5	10.1	44	66.2	55.3	11.8
WB-Grainfield	41.1	56.5	12.7	92.1	60.2	10.0	89	69.9	57.2	11.8
Ideal	40.1	57.5	13.1	80.8	62.1	9.9	22	63.5	58.7	11.8
Lyman	37.6	56.5	13.9	78.9	61.0	10.7	22	64.7	57.9	11.9
LCS Mint	48.7	58.1	11.9	92.2	62.3	10.3	89	73.3	59.5	11.6
SY Monument	39.6	56.2	11.3	94.3	59.7	10.4	67	70.7	56.5	11.6
Oahe	45.0	58.2	12.3	65.5	62.0	9.7	33	63.9	59.6	11.8
Overland	30.6	58.2	12.5	82.4	60.9	10.6	56	66.6	58.7	11.5
PSB13NEDH-7-140†	41.4	58.4	13.0	78.9	62.2	10.9	44	66.0	60.0	12.2
Redfield	38.3	57.8	13.3	77.4	61.4	10.0	0	63.9	58.5	12.2
Ruth	35.4	58.0	11.7	75.2	60.4	10.6	33	65.6	58.3	12.2
SY Sunrise†	39.8	57.6	11.1	91.6	61.7	10.5	44	68.0	58.2	12.0
WB4059-CLP	40.8	51.2	12.1	84.2	57.8	10.6	11	62.6	52.8	12.1
WB4614	44.7	57.2	13.6	92.9	61.7	10.8	67	67.7	58.1	11.9
Wesley	45.6	55.5	12.9	87.9	60.7	9.8	33	65.8	56.7	12.3
SY Wolf	43.9	55.5	12.5	86.1	61.4	10.2	44	67.1	57.9	11.9
Trial Average	38.3	56.8	12.7	83.8	61	10.2	-	65.0	57.7	12.0
LSD(0.05)‡	8.5	1.9	1.2	12.9	1.8	1.6	-	3.2	0.8	0.5
CV(%)§	15.9	2.3	7.0	11.1	2.1	11.3	-	9.9	2.8	6.5

† New entry in 2016, not previously tested.

‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, § Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

2016 South Dakota Winter Wheat Variety Trial Results

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Table 5. 2014-2016 (2 and 3-year averages) East River Yield (bu/ac @ 13% moisture) Performance - sorted by overall 3-year yield. Varieties yielding in the upper 1/3 for each trial location are denoted by gray shading.

Variety	Zone - 1	Crop Zone - 2				Crop Zone - 3		Crop Zone - 4		Crop Zones 1-4	
	Selby	Brookings		Brookings-fung.		Beresford		Onida		East River Ave.	
	2 year	2 year	3 year	2 year	3 year	2 year	3 year	2 year	3 year	2 year	3 year
SY Wolf	95.6	64.6	65.4	64.5	66.8	81.7	75.2	63.6	76.6	75.4	78.1
Oahe	98.6	59.1	61.4	66.4	68.0	73.3	71.4	62.1	71.3	73.5	75.8
Freeman	96.7	60.1	61.7	57.2	62.1	82.2	75.8	60.1	72.0	72.8	75.5
WB-Grainfield	99.2	57.3	59.3	61.2	62.2	81.4	73.4	61.8	72.7	72.9	74.5
Redfield	99.3	54.3	54.0	64.0	62.9	74.8	69.5	63.5	74.5	72.4	73.8
Denali	83.7	58.5	55.2	69.6	66.4	83.8	73.5	62.4	70.4	73.5	73.6
LCS Mint	90.7	54.4	56.8	62.9	63.6	79.2	69.3	64.5	74.6	72.2	73.4
Ideal	84.5	55.7	56.2	60.5	63.1	75.3	72.6	52.5	69.8	68.8	73.3
Overland	98.9	54.0	55.4	61.5	64.0	71.6	68.4	61.3	70.6	71.7	73.3
Lyman	91.1	58.6	59.2	58.7	61.6	71.7	67.1	60.3	72.5	70.8	72.9
Wesley	88.8	52.8	55.1	57.0	58.2	78.5	69.0	51.5	65.3	67.4	69.6
Byrd	81.3	49.1	49.7	56.7	56.5	81.1	70.7	61.9	69.4	68.9	69.4
Alice	96.8	47.5	47.3	48.9	53.0	73.3	62.4	59.9	67.1	68.5	67.7
Decade	76.9	48.0	50.5	57.8	56.9	69.8	65.7	51.0	66.7	63.3	67.0
Expedition	80.2	49.0	49.1	51.3	53.5	78.8	68.9	56.0	66.0	66.5	66.7
Brawl CL Plus	92.8	41.6	42.3	50.9	51.2	81.9	70.0	60.1	64.1	68.3	66.3
Antero	94.4	58.5	-	70.5	-	80.5	-	67.0	-	75.6	-
SY Monument	94.7	58.5	-	68.1	-	77.3	-	63.5	-	74.1	-
Ruth	95.8	54.2	-	61.5	-	78.3	-	60.9	-	71.8	-
LCS Compass	81.9	46.6	-	54.0	-	85.3	-	54.4	-	67.8	-
WB4614	73.9	50.8	-	67.7	-	70.0	-	51.6	-	64.9	-
AC Emerson	82.5	52.6	-	51.7	-	65.3	-	55.9	-	62.5	-
WB4059CLP	84.0	42.6	-	40.7	-	75.9	-	41.4	-	59.4	-
Avery†	-	-	-	-	-	-	-	-	-	-	-
Cowboy†	-	-	-	-	-	-	-	-	-	-	-
PSB13NEDH-7-140†	-	-	-	-	-	-	-	-	-	-	-
SY Sunrise†	-	-	-	-	-	-	-	-	-	-	-
Trial Average	90.9	53.2	54.5	58.4	60.0	76.6	68.3	59.3	70.2	69.2	69.8
LSD(0.05)‡	7.0	5.0	3.9	4.9	4.1	6.9	4.7	6.1	4.1	8.6	6.0

† New entry in 2016, not previously tested.

‡ Yield value required (≥LSD) to determine if varieties are statistically different than one another.

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2016 South Dakota Winter Wheat Variety Trial Results

Table 6a. 2014-2016 (2 and 3-year averages) West River Yield (bu/ac @ 13% moisture) Performance - sorted by overall 3-year yield. Varieties yielding in the upper 1/3 for each trial location are denoted by gray shading.

Variety	Crop Zone - 5		Crop Zone - 6						
	Martin		Hayes	Kennebec		Sturgis		Wall	
	2 year	3 year	2 year	2 year	3 year	2 year	3 year	2 year	3 year
SY Wolf	68.4	61.1	62.5	65.9	75.1	71.3	65.6	64.8	60.9
LCS Mint	68.8	64.4	61.5	56.8	67.6	76.8	69.9	71.9	63.9
Denali	71.9	65.0	63.5	51.5	66.0	68.7	64.8	81.4	72.0
Ideal	65.4	61.1	58.4	50.5	68.5	66.4	62.7	71.7	69.2
Oahe	71.7	64.2	58.0	58.2	67.8	72.1	65.2	69.2	66.1
Freeman	71.0	65.3	60.4	53.6	67.4	73.0	64.4	66.0	62.8
WB-Grainfield	71.7	61.9	62.6	62.3	69.3	74.9	65.5	66.6	60.6
Overland	67.2	64.2	59.9	53.7	66.2	69.2	61.6	66.3	59.0
Redfield	65.0	62.1	62.6	55.2	65.5	68.1	61.5	73.3	67.2
Lyman	61.1	57.3	58.3	53.2	65.2	62.5	58.6	62.1	59.8
Decade	59.5	57.3	61.4	46.8	64.1	65.1	60.5	66.5	65.7
Wesley	59.2	56.5	58.7	47.9	61.7	66.5	59.5	61.4	57.7
Byrd	65.1	57.7	58.1	49.4	63.1	69.0	62.2	70.3	61.6
Alice	60.3	54.7	67.3	53.3	62.2	64.8	57.7	58.6	53.5
Expidition	57.2	52.5	59.5	51.4	63.1	62.7	57.8	64.8	56.5
Brawl CL Plus	59.8	51.4	59.4	45.9	53.0	64.1	58.0	60.9	54.7
Antero	71.5	-	57.1	48.5	-	79.1	-	73.2	-
SY Monument	68.7	-	64.0	60.1	-	71.6	-	79.5	-
Ruth	66.9	-	70.2	59.0	-	68.5	-	61.9	-
WB4614	64.6	-	55.8	53.1	-	77.9	-	77.2	-
LCS Compass	63.2	-	56.3	43.3	-	58.7	-	58.0	-
AC Emerson	55.7	-	51.6	50.1	-	59.2	-	59.7	-
WB4059CLP	54.4	-	54.9	29.3	-	61.8	-	56.3	-
Avery†	-	-	-	-	-	-	-	-	-
Cowboy†	-	-	-	-	-	-	-	-	-
PSB13NEDH-7-140†	-	-	-	-	-	-	-	-	-
SY Sunrise†	-	-	-	-	-	-	-	-	-
Trial Average	64.9	59.8	59.4	53.4	67.4	68.3	62.1	66.5	61.7
LSD(0.05)‡	7.1	6.2	8.2	9.1	6.3	4.4	3.3	6.3	5.1

† New entry in 2016, not previously tested.

‡ Yield value required (≥LSD) to determine if varieties are statistically different than one another.

Table 6b. 2014-2016 (2 and 3-year averages) West River Yield (bu/ac @ 13% moisture) Performance, continued - sorted by overall 3-year yield. Varieties yielding in the upper 1/3 for each trial location are denoted by gray shading.

Variety	Crop Zone - 6				Crop Zone - 7				Crop Zones 5-7	
	Winner		Winner intensive		Bison		Faith*		West River Ave.	
	2 year	3 year	2 year	3 year	2 year	3 year	2 year	3 year	2 year	3 year
SY Wolf	77.2	77.9	66.4	70.6	48.4	48.3	70.7	66.3	66.2	65.8
LCS Mint	75.1	75.2	75.3	74.9	48.9	44.5	66.9	58.5	66.9	65.0
Denali	63.8	66.1	71.4	70.1	51.7	47.4	62.2	55.9	65.1	63.9
Ideal	68.6	72.0	68.7	71.4	47.0	44.4	59.7	60.3	61.8	63.7
Oahe	67.2	69.8	70.6	69.2	51.9	46.2	56.7	54.2	63.9	62.9
Freeman	71.5	72.4	70.1	69.1	44.3	40.8	63.5	57.9	63.7	62.8
WB-Grainfield	64.9	69.2	73.1	70.3	49.2	41.8	69.2	59.8	66.0	62.6
Overland	69.6	71.5	72.6	70.6	41.7	41.5	62.9	59.3	62.6	62.0
Redfield	64.4	66.6	67.6	68.4	44.1	41.2	57.5	55.2	62.0	61.6
Lyman	69.8	70.9	73.6	72.9	43.4	42.4	63.4	61.0	60.8	61.4
Decade	60.0	66.2	61.8	66.0	44.6	42.4	57.3	53.7	58.1	60.2
Wesley	63.1	65.9	65.2	68.0	53.1	47.9	60.7	54.5	59.5	59.5
Byrd	66.0	66.4	75.4	71.1	50.4	42.9	56.4	50.5	62.2	59.4
Alice	66.0	64.7	67.3	64.1	39.4	35.5	61.0	58.6	59.8	57.7
Expedition	61.9	64.1	64.5	63.7	42.9	39.4	62.0	56.7	58.6	57.3
Brawl CL Plus	66.7	64.3	66.7	62.5	48.6	42.3	61.2	52.4	59.3	55.6
Antero	80.6	-	82.2	-	50.1	-	74.3	-	68.5	-
SY Monument	74.5	-	71.2	-	46.6	-	71.8	-	67.5	-
Ruth	71.4	-	74.7	-	40.8	-	58.1	-	63.5	-
WB4614	56.9	-	68.4	-	45.1	-	61.5	-	62.3	-
LCS Compass	62.9	-	64.0	-	38.6	-	61.7	-	56.3	-
AC Emerson	48.5	-	49.2	-	39.4	-	63.7	-	53.0	-
WB4059CLP	45.6	-	52.8	-	40.3	-	56.3	-	50.2	-
Avery†	-	-	-	-	-	-	-	-	-	-
Cowboy†	-	-	-	-	-	-	-	-	-	-
PSB13NEDH-7-140†	-	-	-	-	-	-	-	-	-	-
SY Sunrise†	-	-	-	-	-	-	-	-	-	-
Trial Average	67.2	69.9	68.4	69.0	44.6	42.5	62.5	58.0	61.7	61.1
LSD(0.05)‡	5.8	4.6	6.4	4.5	8.9	6.1	7.7	6.1	8.2	6.3

*Faith multiyear averages include data from McLaughlin in 2014 and 2015.

† New entry in 2016, not previously tested.

‡ Yield value required (≥LSD) to determine if varieties are statistically different than one another.

2016 South Dakota Winter Wheat Variety Trial Results

Table 7. List of winter wheat varieties being tested in 2015 along with origin, agronomic, and grain quality characteristics.

Variety	Testing and Origin		Agronomic Characteristics				Grain Quality		
	Years tested in SD trials	Origin†-Year	Rel.‡ Hdg days	Rel.‡ Height inches	Lodging Score§	Winter Hardi-ness¶	2016 Test Wt.	2016 Protein %	Baking Quality#
Alice (White)	5+	SD-06	3	-2	1.8	G	Good	Good	E
Antero (White)	2	PG-12	0	0	2.1	G	Good	Low	*(G)††*
Avery	new	PG-15	3	0	2.5	-	Average	Low	-
Brawl CL Plus	3	PG-11	1	0	1.5	F	Good	Good	*(E)*
Byrd	3	PG-11	2	-1	2.2	*(G)*	Average	Low	*(E)*
LCS Compass	2	LCS-15	0	0	2.1	G	High	Average	*(E)*
Cowboy	new	WY-12	5	-2	2.1	(G)	Low	Average	*(A)*
Decade	3	MT/ND-10	7	-1	1.5	G	Good	Average	*(A)*
Denali	3	CO-11	4	0	1.5	G	Good	Average	*(A)*
AC Emerson	2	MS-15	8	-1	1.2	G	Good	High	*(G)*
Expedition	5+	SD-02	**0**	**0**	2.0	G	Average	Average	G
Freeman	4	NE-13	2	-2	2.4	F	Low	Average	A-G
WB-Grainfield	4	WB-12	1	0	1.9	F	Average	Average	G
Ideal	5+	SD-11	6	0	1.9	G-E	Good	Average	A
Lyman	5+	SD-08	3	0	2.4	G-E	Good	Good	A
LCS Mint	4	LCS-12	1	0	1.9	G	High	Average	*(G)*
SY Monument	2	AP-14	5	-1	1.8	G-E	Low	Average	*(G)*
Oahe	4	SD-16	4	3	2.0	G-E	High	Average	A
Overland	5+	NE-06	4	2	1.9	G-E	High	Good	*(A)*
PSB13NEDH-7-140	new	LCS-exp	6	2	1.2	(G)	High	Good	*(A)*
Redfield	5+	SD-13	5	-1	1.5	G	Good	Good	G
Ruth	2	NE-16	3	0	1.5	G	Good	Good	*(G)*
SY Sunrise	new	AP-15	4	-3	1.5	(E)	Good	Average	-
WB4059-CLP	2	WB-13	3	-4	1.3	G	Very Low	Good	*(G)*
WB4614	2	WB-14	7	-2	1.3	G	Average	Good	-
Wesley[no PVP]	5+	NE-99	3	-2	1.4	G	Low	Good	G
SY Wolf	5+	AP-11	4	-1	1.3	G	Good	Average	A

† AP, AgriPro; LCS, Limagrain Cereal Seeds; MS, Meridian Seeds; MT, Montana; NE, Nebraska (Husker Brand Genetics); ND, North Dakota; PG, PlainsGold; SD, South Dakota; WB, WestBred; WY, Wyoming; and – (Year of Release).

‡ Difference in days to heading compared to **Expedition** (2016 from Brookings and South Shore). Height compared to **Expedition** (34 **inches**) statewide.

§ Lodging score: 1, perfectly standing; to 5, completely flat.

¶ Winter hardiness: E, excellent; G, good; F, fair; P, poor.

Baking quality: E, excellent; G, good; A, acceptable; P, Poor. Note: SDSU does not typically do baking quality analysis.

†† Estimated ratings *(X)*, based on information provided by entity that submitted the variety.

Table 8. Winter wheat variety disease ratings.

Variety	Disease Ratings‡					
	2016 Stripe Rust	Stem Rust	Leaf Rust	Leaf Spot	WSMV	2016 FHB (Scab)
Alice (White)	MS-S	MR	MS	MS-S	MS	MS
Antero (White)	MR	*(MR)¶*	*(S)*	MS-S	*(MS)*	S
Avery†	S	-	-	-	-	MS
Brawl CL Plus	MS-S	*(R)*	*(R)*	S	*(MS)*	MR
Byrd	S	*(MS)*	*(MS)*	S	*(MS)*	MS
LCS Compass	S	*(R)*	MS-MR	S	*(S)*	MR
Cowboy†	S	*(MS)*	*(MS-S)*	-	*(MS)*	S
Decade	S	*(R)*	MR	*(MR)*	-	MR
Denali	S	*(MS)*	MS-S	S	*(MS)*	MR
AC Emerson	MR-MS	*(R)*	MS	S	-	MS
Expedition	S	R	MS-S	MS-S	S	MR
Freeman	S	MR	MS-S	S	S	MS
WB-Grainfield	MR-MS	MR	MR	S	MR	S
Ideal	S	MR	MR-MS	S	S	MS
Lyman	S	R	MR ?	S	S	MR
LCS Mint	MS-S	MS	MS-S	S	MR	S
SY Monument	MR-R	*(R)*	MR	S	*(R)*	MR
Oahe	MR-MS	MS	MR	MS	MR	MR
Overland	S	MR	MR	S	MS	MR
PSB13NEDH-7-140†	MS-S	-	*(MR-MS)*	-	-	MR
Redfield	S	MR	MS-MR	MS-S	S	MR
Ruth	MS-S	*(MR)*	MS-S	S	*(S)*	MS
SY Sunrise†	MR-R	-	-	-	-	MR
WB4059-CLP	S	-	S	MR-MS	-	S
WB4614	MS	-	MS	MS-S	*(S)*	S
Wesley[no PVP]	S	R	MS	S	S	S
SY Wolf	S	MR	MR	MS	MR	S

† new entry in 2016

‡ Disease ratings: R, resistant; MR, moderately resistant; MS, moderately susceptible; S, susceptible.

¶ Estimated rankings based on information provided by the entity that submitted the variety.